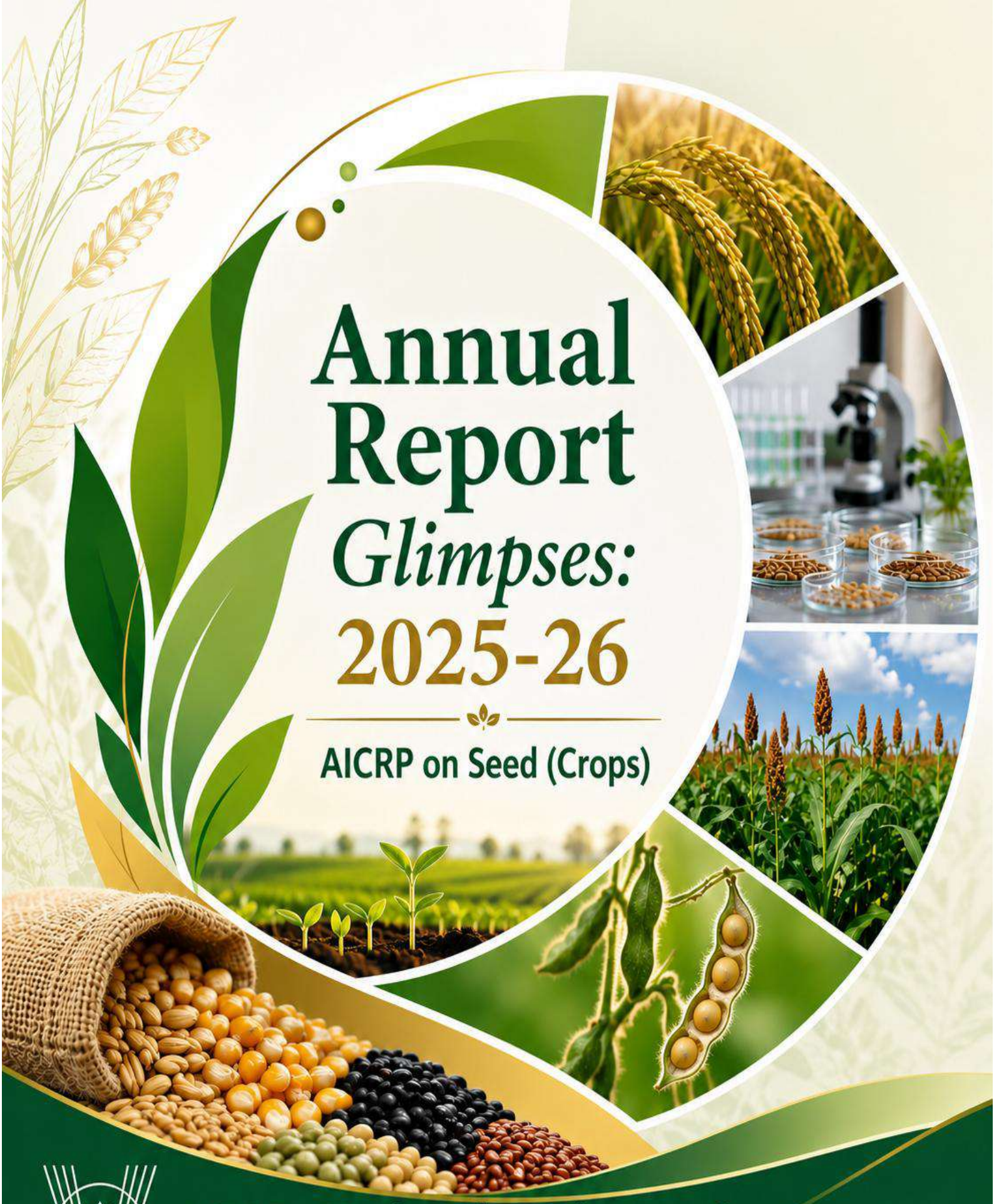


# Annual Report *Glimpses:* 2025-26

## AICRP on Seed (Crops)

भाकृअनुप
ICAR

**ICAR- National Institute of Seed Science & Technology**

(Indian Council of Agricultural Research)

ICAR Parisar, Mau 275103 (UP)

www.seedicar.org.in

# Annual Report: Glimpses

# 2025-26

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***(Indian Council of Agricultural Research)***

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# Preface

Quality seed is the ***numero uno*** input for sustained agricultural production. The pace of advancement in food production is intrinsically linked to the efficiency of a country's seed programme—its ability to multiply and market high-quality seed of superior, high-yielding varieties. The pivotal role of quality seed has been well documented and acknowledged across diverse farming systems. Recognizing this, the Indian Council of Agricultural Research (ICAR) launched the landmark *AICRP on NSP (Crops)* in 1979–80, followed by the *ICAR Seed Project* during the Tenth Five-Year Plan (2005–06).

In alignment with the recommendations of the *Review Committee on AICRPs/AINPs*, ICAR merged these two flagship programmes into a single entity i.e. **AICRP on Seed (Crops)** in 2021–22. The mandate includes the production of breeder seed as per national requirements, augmentation of quality seed production across agricultural crops, and the development of region-specific seed technologies tailored to the evolving needs of the seed sector. In addition, the project plays a vital role in technology dissemination, seed infrastructure development, and capacity building. The project stands as a significant institutional intervention to address strategic challenges such as Seed Replacement Rate (SRR) and Varietal Replacement Rate (VRR).

This **Annual Report 2025-26** is a comprehensive compilation of progress achieved by various cooperating centres under the two key components of the project: *Quality Seed Production (QSP)* and *Seed Technology Research (STR)*. It gives me immense pleasure to place on record my heartfelt gratitude for the dynamic leadership and vision of **Dr. Mangi Lal Jat,** Hon'ble Secretary, DARE & DG, ICAR. His continued guidance has been instrumental in steering the Indian seed production and research fraternity toward excellence. I also acknowledge with deep appreciation the invaluable support of **Dr. D.K. Yadava**, Deputy Director General (CS), the mission leader of this project, for his encouragement and leadership, and **Dr. P.R. Chaudhury**, Assistant Director General (Seed) and Ex-ADG (Seed), **Dr. Sanjeev Gupta**, for their consistent cooperation. I also thank **Dr. Sanjay Kumar**, Ex-Director, ICAR-NISST, Mau for heading the project during the past years.

We are grateful to the Seed Division, DA&FW, for their collaboration in effective implementation of the BSP programme. My sincere thanks to all the Nodal Officers and scientists of the cooperating centres, whose dedicated efforts ensured the successful implementation of the project. I gratefully acknowledge the unwavering support and scientific inputs of the Project's Principal Investigators, **Dr. Sandeep K. Lal, Dr. S.K. Yadav, Dr. Atul Kumar, Dr. Amit Bera, and Dr. Ashwani Kumar** and Co-Principal Investigators, **Dr. Bhojaraja Naik K., Dr. Udaya Bhaskar K., Dr. Anjitha George, Dr. A.N. Singh, Dr. Ashish Kumar, and Dr. P. Sivamma** for their meticulous technical compilations and programme execution. I would also like to acknowledge the scientists and staff of ICAR- NISST, Mau, particularly **Dr. Sripathy K.V., Dr. Udaya Bhaskar K., Dr. Kalyanrao, and Dr. Kalyani Kumari** for their commendable efforts in nationwide coordination of this extensive programme.

I firmly believe that this project will continue to pave the way toward national seed self-sufficiency and ensure robust, quality seed-driven growth in Indian agriculture through technological empowerment and collaborative effort.



**A. Anandan**
Director, ICAR-NISST, Mau

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# Introduction

Seed provides foundation to productive agriculture, be it crop husbandry, horticulture or fisheries. It is cheapest input among all and plays seminal role in enhancing agricultural productivity. The seed sector plays a major role in the dissemination of latest agricultural technologies to farmers through high quality seeds of high yielding varieties as exemplified by consistent increase and record production of field crops. AICRP on Seed (Crops) played its part in augmenting quality seed production (breeder seed & other classes), research back up on various aspects of seed science and technology, infrastructure establishment to support seed activities, seed related technology dissemination, capacity building and more importantly making seeds available at right place and time by innovative model deployment (participatory seed production and seed village programme etc.). The development of high yielding varieties/ hybrids of wheat, rice, maize, pearl millet and sorghum in early sixties were the landmark beginning for development of the seed programme in the country. The World Bank assisted considerably for strengthening of Indian seed programme by launching NSP I in 1977-78 and subsequently NSP II in the following year. The ICAR along with its partner *i.e.* SAUs shouldered the responsibility of producing the breeder seed through launch of All India Coordinated Research Project on seed called 'National Seed Project (Crops)' in 1979-80 with two components *viz*. Breeder Seed Production (BSP) and Seed Technology Research (STR). The seed programme of the country was further strengthened with NSP III through World Bank assistance in 1989-90, which not only supported the ICAR and SAUs but also Department of Agriculture Corporation and Farmers Welfare (DAC&FW), Seeds Corporations, Seed Certification Agencies and Private Seed Industry to a great extent in production, processing and in providing quality seeds to the farmers. Similarly, in a bid to foster seed multiplication chain and for strengthening seed production infrastructure facilities in the country, ICAR launched ICAR Seed Project- 'Seed Production in Agricultural Crops' during 2005-06. As per the recommendations of 'Review Committee on AICRPs/AINPs of ICAR', the two flagship seed



programmes of ICAR were merged into single entity and rechristened as AICRP on Seed (Crops) during 2021-22 with two components viz. Quality Seed Production (QSP) and Seed Technology Research (STR).

The AICRP on Seed (Crops) is mandated to produce breeder seed as per national requirement, to augment quality seed production among agricultural crops and to develop region specific seed technologies as per the contemporary needs of seed industry under five broad theme areas of seed science *viz*. seed production and certification; seed physiology, storage and testing; seed pathology, seed entomology and seed processing. During 2025-26, Quality Seed Production and Seed Technology Research components were operational at 68 centres and 26 centres respectively, under AICRP on Seed (Crops) at various SAUs and ICAR institutes across the country.

**Mission of AICRP-NSP (Crops)**

To ameliorate Seed Replacement Rate (SRR) and Varietal Replacement Rate (VRR) through production of adequate quantity of quality seed and to develop region specific seed technologies for improved yield and production.

**Mandates of AICRP-NSP (Crops)**

- To produce breeder seed as per national requirement and augment quality seed production among agricultural crops in the country.
- To conduct, coordinate and monitor research on different aspects of seed science and technology.
- Qualitative and quantitative enhancement in seed production capabilities of institutions under NARES
- Capacity building among various stake holders on seed production, processing, storage & packaging, quality control and seed health.
- To establish linkages with Crop Improvement Projects, Seed Industry, Seed Regulatory Agencies, NGOs, KVKs etc.

**Cooperating centres& location**

During 2025-26, 68 quality seed production and 26 seed technology research centres are in existence under AICRP on Seed (Crops).

| S. No. | Quality Seed Production (QSP) | S. No. | Seed Technology Research (STR) |
|---|---|---|---|
| **A** | **State Agricultural University (SAUs)** | **A** | **State Agricultural University (SAUs)** |
| 1 | CSKHPKV, Palampur | 1 | AAU, Anand |
| 2 | PAU, Ludhiana | 2 | CCSHAU, Hisar |
| 3 | CCSHAU, Hisar | 3 | CSAUAT, Kanpur |
| 4 | GBPUAT, Pantnagar | 4 | GBPUAT, Pantnagar |
| 5 | NDUAT, Faizabad | 5 | CSKHPAU, Palampur |

| S. No. | Quality Seed Production (QSP) | S. No. | Seed Technology Research (STR) |
|---|---|---|---|
| 6 | CSAUAT, Kanpur | 6 | JAU, Junagadh |
| 7 | OUAT, Bhubaneswar | 7 | JNKVV, Jabalpur |
| 8 | JNKVV, Jabalpur | 8 | MPKV, Rahuri |
| 9 | VNMKV, Parbhani | 9 | NDUAT, Faizabad |
| 10 | MPKV, Rahuri | 10 | OUAT, Bhubaneswar |
| 11 | PDKV, Akola | 11 | PAJANCOARI, Karaikal |
| 12 | UAS, Bangalore | 12 | PAU, Ludhiana |
| 13 | UAS, Dharwad | 13 | PDKV, Akola |
| 14 | PJTSAU, Hyderabad | 14 | PJTSAU, Hyderabad |
| 15 | TNAU, Coimbatore | 15 | SKNAU, Jobner |
| 16 | SKUAST, Srinagar | 16 | SKUAST, Srinagar |
| 17 | AAU, Anand | 17 | TNAU, Coimbatore |
| 18 | PAJANCOA&RI, Karaikal | 18 | UAS, Bangalore |
| 19 | VSI, Pune | 19 | UAS, Dharwad |
| 20 | AU, Kota | 20 | VNMKV, Parbhani |
| 21 | BAU, Ranchi | 21 | ANGRAU, Guntur |
| 22 | BCKV, Nadia | **B** | **SAUs – NEH Region** |
| 23 | SKRAU, Bikaner | 22 | AAU, Jorhat |
| 24 | SDAU, SK Nagar | **C** | **Central Agricultural University (CAUs)** |
| 25 | SKNAU, Jobner | 23 | RPCAU, Pusa |
| 26 | IGKV, Raipur | **D** | **ICAR Institutes** |
| 27 | KKV, Dapoli | 24 | ICAR-CAZRI, Jodhpur |
| 28 | KAU, Trissur | 25 | ICAR-IARI, New Delhi |
| 29 | UAS, Raichur | 26 | ICAR-NISST, Mau |
| 30 | SKUAST, Jammu | | |
| 31 | SVPUAT, Meerut | | |
| 32 | UBKV, Pundibari | | |
| 33 | NAU, Navsari | | |
| 34 | BAU, Sabour | | |
| 35 | UAHS, Shimogga | | |
| 36 | ANGRAU, Guntur | | |
| 37 | RVSKVV, Gwalior | | |
| 38 | MPUAT, Udaipur | | |
| 39 | JAU, Junagadh | | |
| 40 | BUAT, Banda | | |
| **B** | **ICAR Institutes** | | |
| 41 | ICAR-CRIJAF, Barrackpore | | |
| 42 | ICAR-NRRI, Cuttack | | |
| 43 | ICAR-IGFRI, Jhansi | | |
| 44 | ICAR-CICR, Nagpur | | |
| 45 | ICAR-IIRR, Hyderabad | | |
| 46 | ICAR-IIMR, Hyderabad | | |
| 47 | ICAR-IIOR, Hyderabad | | |

| S. No. | Quality Seed Production (QSP) | S. No. | Seed Technology Research (STR) |
|---|---|---|---|
| 48 | ICAR-IIWBR, Karnal | | |
| 49 | ICAR-IIRMR, Bharatpur | | |
| 50 | ICAR-NSRI, Indore | | |
| 51 | ICAR-IIGR, Junagadh | | |
| 52 | ICAR-IISR, Lucknow | | |
| 53 | ICAR-SBI, Coimbatore | | |
| 54 | ICAR-NISST, Mau | | |
| 55 | ICAR-IIMR, Ludhiana | | |
| 56 | ICAR-CCARI, Goa | | |
| 57 | ICAR-CIARI, Port Blair | | |
| 58 | ICAR- VPKAS, Almora | | |
| 59 | ICAR-IIPR, Kanpur | | |
| 60 | ICAR-CAZRI, Jodhpur | | |
| 61 | ICAR-IARI, New Delhi | | |
| 62 | ICAR-IARI, Jharkhand | | |
| **C** | **SAUs – NEH Region** | | |
| 63 | AAU, Jorhat | | |
| **D** | **Central Agricultural University (CAUs)** | | |
| 64 | BHU, Varanasi | | |
| 65 | RPCAU, Pusa | | |
| 66 | CAU, Imphal | | |
| 67 | RLBCAU, Jhansi | | |
| **E** | **ICAR Institutes – NEH Region** | | |
| 68 | ICAR RC for NEH, Manipur | | |

**Thrust areas in Quality Seed Production**

- Production of adequate quantities of breeder seed as per national requirement.
- Augmenting the availability of foundation, certified and truthfully labelled seed in the country.
- Production of disease-free planting material in vegetatively propagated field crops.
- Quality maintenance of nucleus and breeder seeds by employing dynamic maintenance breeding and rapid genetic purity testing tools.
- Identification of suitable seed provenance for institution of 'National Seed Reserves', with special emphasis on pulses & oilseeds in states of Maharashtra, Madhya Pradesh, Rajasthan, Karnataka, Andhra Pradesh and Telangana.
- Strengthening of seed infrastructure facilities and seed production capabilities of cooperating centers.
- Human resource development and technology dissemination pertinent to seed realm.

**Thrust areas in Seed Technology Research**

**a. Seed production and certification**

- Identification of suitable alternative areas/ provenances for seed production in a bid to counter the effects of climate change.
- Development and optimization of climate resilient seed production technology.
- Harmonization of seed standards in tune to the needs of global seed certification standards.
- Optimization of micro-nutrients and growth regulators in relation to reproductive behaviour to augment the seed yield.
- Development of seed production packages and seed certification standards for underutilized crops.
- To explore upon new planting methodologies/ geometries in a bid to optimize seed rate in tune to realization of higher seed yields (revisiting SMRs).

**b. Seed physiology, testing and storage**

- Validation/up-gradation of field and seed standards/protocols, isolation distance, sample size, physical purity and ODV's in varied crops.
- Standardization of seed testing procedures in field, vegetable, medicinal and green manure crops.
- Standardization of DNA finger printing/molecular markers tools to supplement GOT.
- Use of second and third generation tools for seed quality enhancement.
- Identification of seed vigour traits as a sensitive measure of seed quality in major crops.
- Identification of suitable seed treatments / materials / methods for safe storage of seed.

**c. Seed pathology**

- Identification of disease-free zones for quality seed production.
- Development of rapid and reliable techniques for detection, identification and screening of seed materials for different seed borne diseases.
- Development of integrated strategies for management of seed borne diseases.
- Development of field and seed standards for seed borne diseases and strengthening of work on biological control of seed borne diseases.
- Revisiting of field and seed standards for seed-borne diseases.
- Monitoring, detection, and management of new seed borne diseases.

**d. Seed entomology**

- Pest risk analysis for efficient management of insect pests under seed storage.
- Evaluation of new insecticide molecules for management of storage insects.
- Development of integrated management strategies for management of storage insects.
- Management of insect pollinators for increasing pollination efficiency and seed set.

- Determining the efficacy of novel packaging material with new chemistry for management of storage insects.

**e. Seed processing**

- Standardization of grading sieve sizes (top & bottom sieves) and processing methodologies for new crop varieties/ parental lines.
- Bringing mechanization in seed production to march towards precision farming.

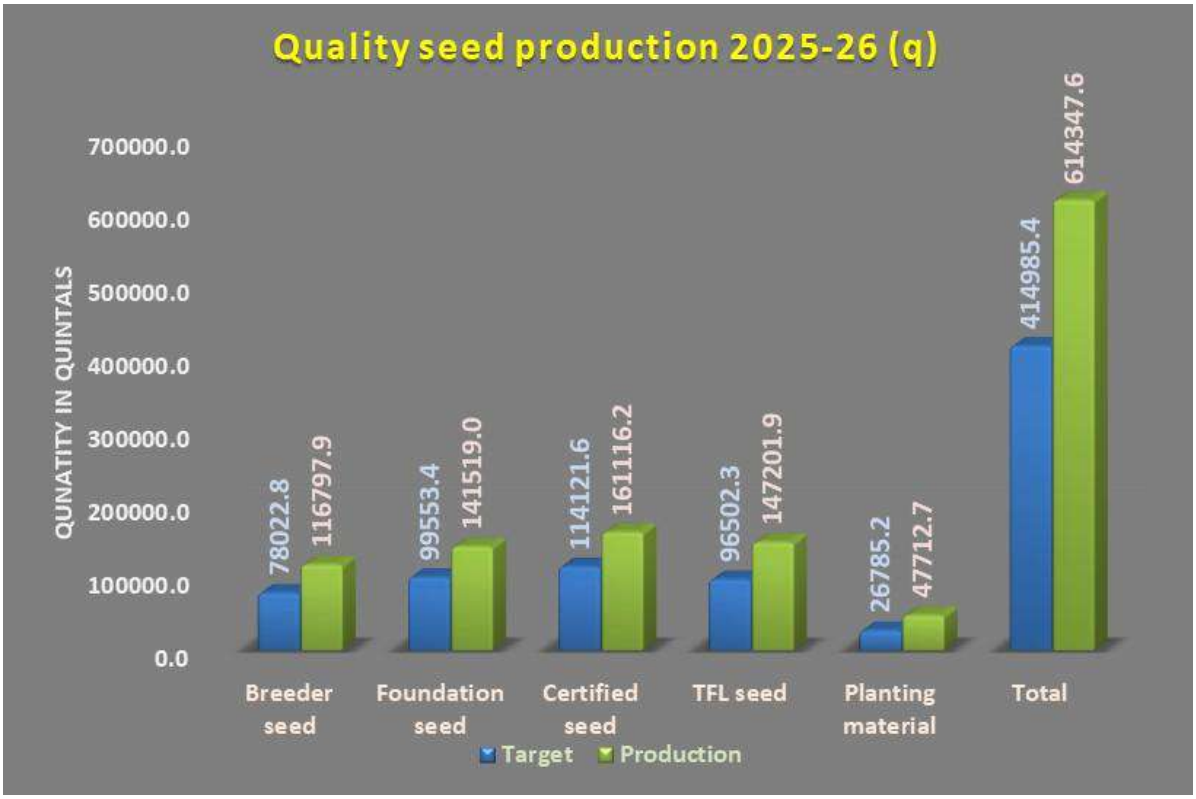
## Quality Seed Production during 2025-26

### Quality seed production

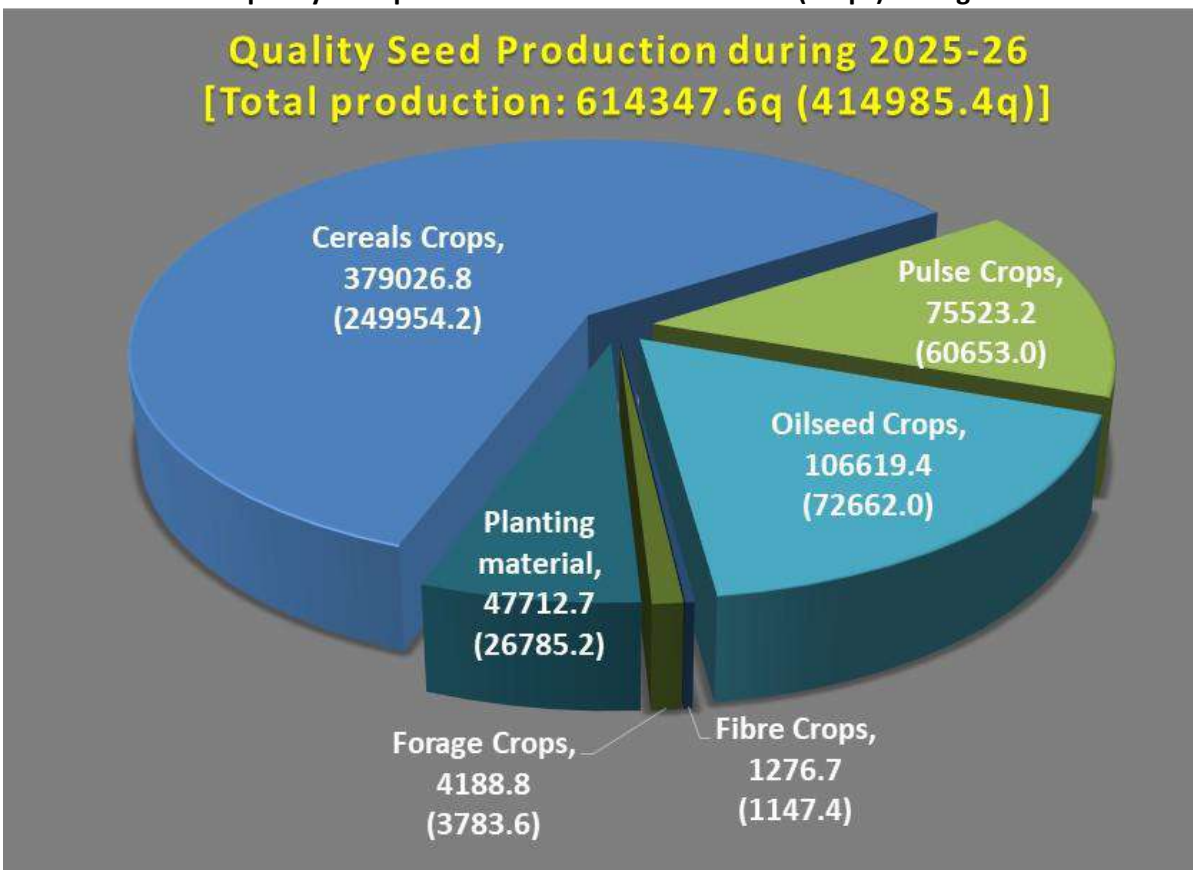
During the year 2025-26 (Rabi, 2024-25 & Kharif, 2025), total quality seed production in various field crops was 614347.62 q against the target of 414985.37 q. Production comprises of 116797.95 q of breeder seed against the indent of 78022.82 q, 141518.99 q of foundation seed against the target of 99553.43 q, 161116.17 q of certified seed against the target of 114121.62 q, 147201.86 q of truthfully labelled seed against the target of 96502.28 q and 47712.66 q of planting material against the target of 26785.22 q. In addition, 205.33 lakh planting material and 12.42 lakh tissue culture plantlets were produced against the targets of 184.80 and 8.80 lakhs, respectively. Apart from a marginal shortfall in a few varieties attributable to climatic vagaries, the major breeder seed requirements across various crops have been successfully met as per the indents. A detailed perusal of the production statistics clearly indicates that the current level of breeder seed production not only fulfills the national requirement but also provides a surplus, sufficient for producing the requisite quantity of certified seed, which is critical to achieving the targeted Seed Replacement Rates (SRR) in a diverse range of crops.




**Last five years- Trends in quality seed production**




**Class-wise quality seed production under AICRP on Seed (Crops) during 2024-25**

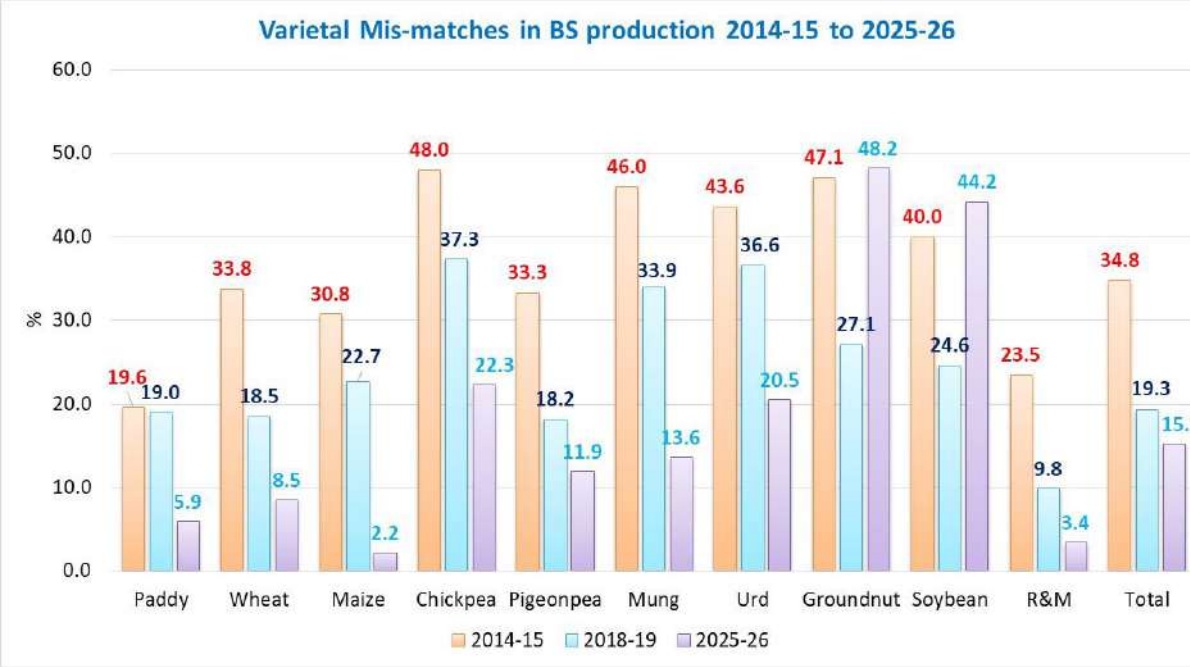



**Values in parentheses indicate targets**

**Commodity-wise quality seed production under AICRP on Seed (Crops) during 2025-26**

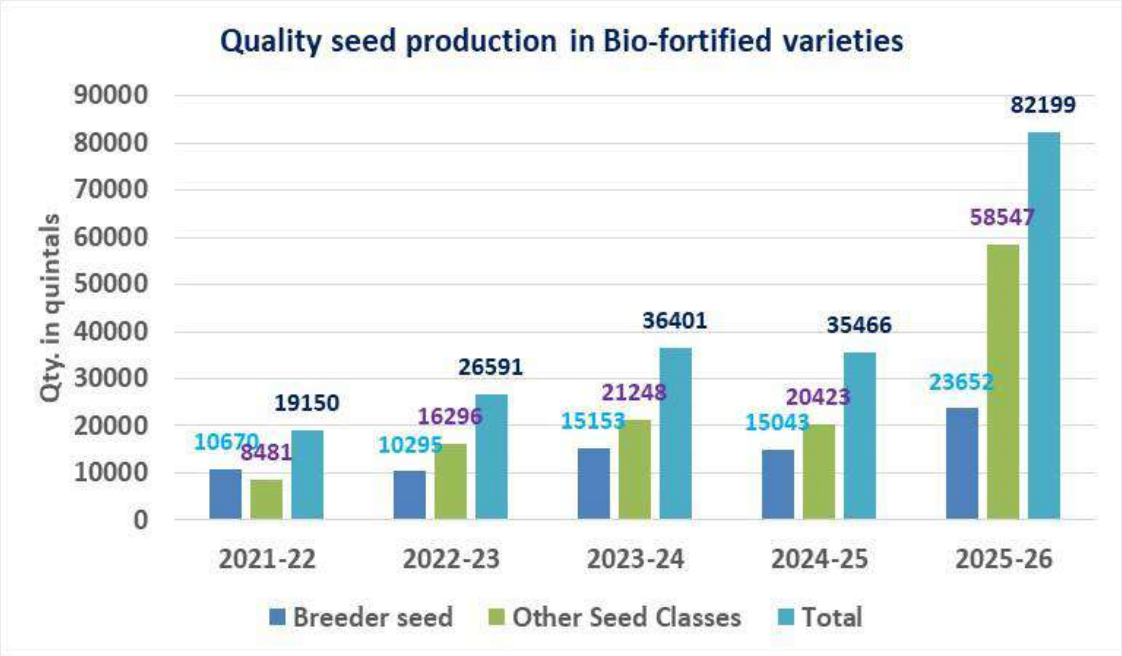
**Varietal mis-match in breeder seed production**

Quantum of breeder seed production always surpassed the indents reflects successful progression of AICRP on Seed (Crops). Imperceptible varietal mis-matches in breeder seed production were observed during past years, below referred illustration clearly depicts that, there is a discernible decrease in mis-matches observed in all major field crops. For example, during the year 2014-15; among 1172 varieties in seed chain, mis-match was reflected in 408 varieties (34.8%). In comparison, during 2018-19, 2019-20, 2020-21, 2021-22, 2022-23, 2023-24, 2024-25 and 2025-26; among 1302, 1296, 1388, 1399, 1556, 1798, 1827 and 1922 varieties in seed chain, mis-matches were reflected in 251 (19.3%), 226 (17.4%), 235 (16.9%), 183 (13.1%), 207 (13.3%), 217 (12.1%), 217 (11.9%) and 292 (15.2%) varieties, respectively.




**Quality seed production in bio-fortified varieties**

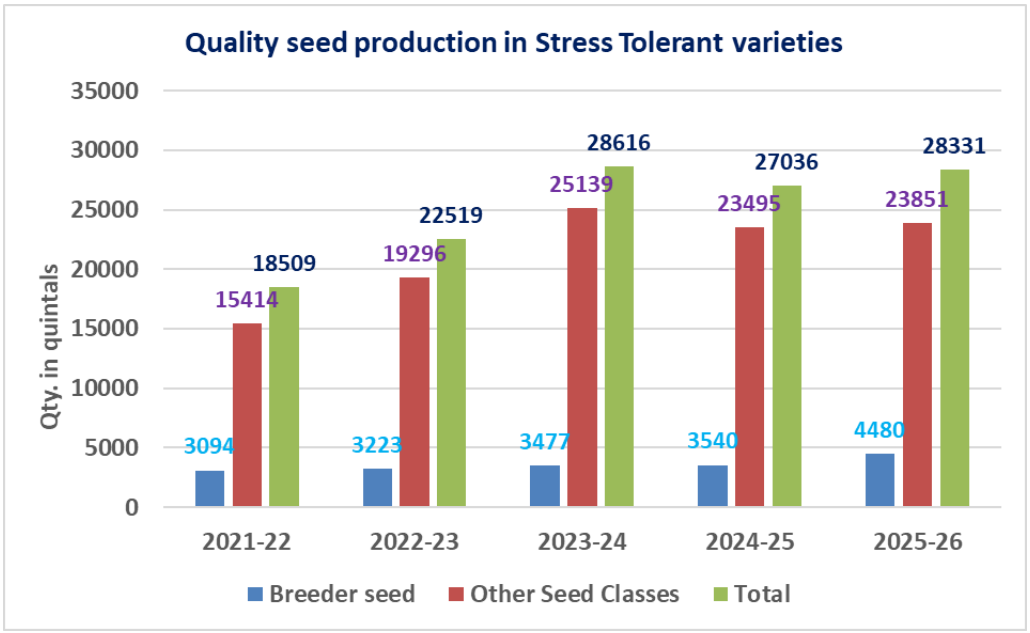
Under the ambit of AICRP on Seed (Crops), due emphasis has been given for quality seed production of bio-fortified crop varieties and thereby contributing part in addressing nutritional security via seed as a carrier in this regard. During the 2025-26, 82199.17 quintals of quality seed was produced in bio-fortified varieties. Production comprises of 23652.08 q of breeder seed and 58547.10 q of other classes of seed (F/S, C/S and TFL).




**Quality seed production in bio-fortified crop varieties during 2021-22 to 2025-26**

**Quality seed production in multiple stress tolerant varieties**

Under the ambit of AICRP on Seed (Crops), due emphasis has been given for quality seed production of extreme stress tolerant (flood, drought and chilling) crop varieties. During the 2025-26, 28331.10 quintals of quality seed was produced in multiple stress tolerant crop varieties. Production comprises of 4480.23 q of breeder seed and 23850.87 q of other classes of seed (F/S, C/S and TFL).




**Quality seed production in multiple stress tolerant varieties during 2021-22 to 2025-26**

**Table 2.1: Summary of centre-wise quality seed production in university/ institute farms (Rabi 2024-25 and Kharif 2025)**

**(In quintals)**

| Sl. No. | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 1 | AAU, Anand | 990.29 | 1293.23 | 225.00 | 243.80 | 2270.00 | 2376.80 | 1316.00 | 1538.28 | **4801.29** | **5452.11** |
| 2 | ANGRAU, Guntur | 9763.56 | 8027.52 | 8994.50 | 10132.18 | 1553.00 | 1474.07 | 1017.50 | 969.01 | **21328.56** | **20602.78** |
| 3 | AU, Kota | 588.89 | 466.10 | 0.00 | 0.00 | 0.00 | 0.00 | 3675.00 | 3815.90 | **4263.89** | **4282.00** |
| 4 | BAU, Ranchi | 74.50 | 157.02 | 1002.00 | 1072.47 | 0.00 | 0.00 | 0.00 | 0.00 | **1076.50** | **1229.49** |
| 5 | BAU, Sabour | 850.49 | 858.90 | 4445.00 | 6455.45 | 2322.50 | 1850.85 | 53.00 | 175.34 | **7670.99** | **9340.54** |
| 6 | BCKV, Mohanpur | 52.67 | 64.62 | 373.30 | 398.80 | 1593.50 | 1754.00 | 571.20 | 637.00 | **2590.67** | **2854.42** |
| 7 | BHU, Varanasi | 120.30 | 186.95 | 662.90 | 688.92 | 1280.10 | 1314.80 | 2462.30 | 2515.80 | **4525.60** | **4706.47** |
| 8 | BSKKV, Dapoli | 61.10 | 149.79 | 89.40 | 140.88 | 120.00 | 147.24 | 730.90 | 768.53 | **1001.40** | **1206.44** |
| 9 | CCSHAU, Hisar | 1107.55 | 1939.99 | 2522.00 | 2542.74 | 3936.00 | 3976.38 | 4718.00 | 4471.71 | **12283.55** | **12930.82** |
| 10 | CSAUAT, Kanpur | 203.95 | 1098.48 | 261.20 | 342.94 | 0.00 | 0.00 | 0.00 | 1369.63 | **465.15** | **2811.05** |
| 11 | CSKHPKV, Palampur | 358.10 | 373.59 | 293.70 | 322.69 | 6.35 | 0.35 | 43.60 | 44.54 | **701.75** | **741.17** |
| 12 | GBPUAT, Pantnagar | 453.40 | 6869.90 | 0.00 | 0.00 | 0.00 | 156.00 | 0.00 | 499.29 | **453.40** | **7525.19** |
| 13 | IGKV, Raipur | 1408.72 | 1755.28 | 0.00 | 8971.25 | 0.00 | 4093.24 | 0.00 | 0.00 | **1408.72** | **14819.77** |
| 14 | JAU, Junagadh | 9346.57 | 9314.62 | 1905.30 | 2530.55 | 15.00 | 1160.10 | 2623.00 | 3538.85 | **13889.87** | **16544.12** |
| 15 | JNKVV, Jabalpur | 3202.87 | 9900.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **3202.87** | **9900.16** |
| 16 | KAU, Thrissur | 30.55 | 32.50 | 0.00 | 0.00 | 0.00 | 0.00 | 213.36 | 225.17 | **243.91** | **257.67** |
| 17 | MPKV, Rahuri | 2642.80 | 5961.26 | 60.00 | 70.36 | 450.00 | 366.00 | 1015.55 | 1225.15 | **4168.35** | **7622.77** |
| 18 | MPUAT, Udaipur | 475.13 | 442.53 | 670.00 | 675.20 | 2885.00 | 2943.28 | 0.00 | 0.00 | **4030.13** | **4061.01** |
| 19 | NAU, Navsari | 112.56 | 226.25 | 267.73 | 286.68 | 696.54 | 742.77 | 2174.11 | 2294.43 | **3250.94** | **3550.13** |
| 20 | NDUAT, Ayodhya | 425.00 | 472.74 | 7454.50 | 7798.19 | 1522.00 | 1541.20 | 0.00 | 0.00 | **9401.50** | **9812.13** |
| 21 | RLBCAU, Jhansi | 0.00 | 45.40 | 200.00 | 272.85 | 100.00 | 133.00 | 0.00 | 6.80 | **300.00** | **458.05** |

| Sl. No. | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 22 | BUAT, Banda | 0.00 | 104.50 | 235.00 | 315.33 | 0.00 | 0.00 | 15.00 | 27.80 | **250.00** | **447.63** |
| 23 | OUAT, Bhubaneswar | 374.77 | 325.00 | 6236.00 | 6303.47 | 178.50 | 183.10 | 66.74 | 68.35 | **6856.01** | **6879.92** |
| 24 | PAJANCOA&RI, Karaikal | 9.00 | 9.15 | 29.00 | 32.10 | 0.00 | 0.00 | 6.00 | 15.50 | **44.00** | **56.75** |
| 25 | PAU, Ludhiana | 1550.85 | 4091.45 | 11426.50 | 11690.00 | 28110.00 | 28958.80 | 18499.20 | 19006.75 | **59586.55** | **63747.00** |
| 26 | PDKV, Akola | 4077.89 | 13324.79 | 105.00 | 120.57 | 1506.20 | 1832.00 | 1107.00 | 1337.17 | **6796.09** | **16614.53** |
| 27 | PJTSAU, Hyderabad | 1068.00 | 1282.95 | 69.00 | 78.00 | 0.00 | 0.00 | 0.00 | 0.00 | **1137.00** | **1360.95** |
| 28 | RPCAU, Pusa | 1191.99 | 755.23 | 3456.50 | 3400.74 | 1409.60 | 2064.65 | 373.60 | 420.46 | **6431.69** | **6641.08** |
| 29 | RVSKVV, Gwalior | 5220.50 | 4723.98 | 0.00 | 0.00 | 0.00 | 0.00 | 1535.00 | 1690.00 | **6755.50** | **6413.98** |
| 30 | SDAU, S.K. Nagar | 4116.59 | 5394.20 | 0.00 | 84.18 | 0.00 | 123.45 | 0.00 | 1077.01 | **4116.59** | **6678.84** |
| 31 | SKRAU, Bikaner | 928.11 | 1021.85 | 491.50 | 507.03 | 1682.00 | 1741.83 | 1038.00 | 1099.70 | **4139.61** | **4370.41** |
| 32 | SKUAST, Jammu | 316.96 | 275.02 | 1200.00 | 982.03 | 0.00 | 0.00 | 0.00 | 151.20 | **1516.96** | **1408.25** |
| 33 | SKUASTK, Srinagar | 116.51 | 233.39 | 756.00 | 833.50 | 75.00 | 80.00 | 573.00 | 695.98 | **1520.51** | **1842.87** |
| 34 | SVBPUAT, Meerut | 288.00 | 428.43 | 2323.00 | 2181.81 | 120.00 | 186.43 | 221.00 | 313.79 | **2952.00** | **3110.46** |
| 35 | TNAU, Coimbatore | 2364.81 | 2522.17 | 5888.50 | 3514.79 | 272.00 | 275.00 | 6393.73 | 6732.58 | **14919.04** | **13044.54** |
| 36 | UAHS, Shimoga | 266.15 | 172.14 | 216.00 | 258.25 | 2672.00 | 2549.00 | 0.00 | 0.00 | **3154.15** | **2979.39** |
| 37 | UAS, Bangalore | 953.30 | 1188.11 | 353.00 | 385.21 | 454.00 | 922.80 | 156.50 | 160.45 | **1916.80** | **2656.57** |
| 38 | UAS, Dharwad | 4601.34 | 6542.55 | 11121.00 | 12994.00 | 3326.00 | 3457.60 | 120.00 | 120.00 | **19168.34** | **23114.15** |
| 39 | UAS, Raichur | 625.75 | 830.60 | 547.00 | 494.00 | 910.00 | 872.00 | 124.00 | 239.00 | **2206.75** | **2435.60** |
| 40 | UBKV, Pundibari | 23.65 | 35.10 | 200.00 | 200.00 | 1360.00 | 1340.00 | 680.00 | 672.50 | **2263.65** | **2247.60** |
| 41 | VNMKV, Parbhani | 1353.68 | 1937.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2020.34 | **1353.68** | **3958.08** |
| 42 | AAU, Jorhat | 159.65 | 553.77 | 845.70 | 2142.38 | 1014.50 | 1547.48 | 81.75 | 421.36 | **2101.60** | **4664.99** |
| 43 | CAU, Imphal | 0.00 | 12.85 | 0.00 | 0.00 | 500.00 | 587.86 | 0.00 | 0.00 | **500.00** | **600.71** |
| 44 | ICAR-CAZRI, Jodhpur | 19.20 | 35.56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 611.95 | **19.20** | **647.51** |

| Sl. No. | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 45 | ICAR-CCARI, Goa | 31.00 | 25.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.50 | **31.50** | **26.20** |
| 46 | ICAR-CIARI, Port Blair | 4.45 | 5.20 | 0.00 | 0.00 | 0.00 | 0.00 | 3.50 | 4.15 | **7.95** | **9.35** |
| 47 | ICAR-CICR, Nagpur | 25.50 | 44.43 | 0.00 | 0.00 | 21.50 | 30.10 | 30.00 | 40.00 | **77.00** | **114.53** |
| 48 | ICAR-CRIJAF, Barrackpore | 42.10 | 20.80 | 0.00 | 0.00 | 300.00 | 321.50 | 348.00 | 411.48 | **690.10** | **753.78** |
| 49 | ICAR-IIGR, Junagadh | 6656.19 | 8558.85 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **6656.19** | **8558.85** |
| 50 | ICAR-IIRMR, Bharathpur | 15.89 | 48.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **15.89** | **48.90** |
| 51 | ICAR-IARI, New Delhi | 1632.16 | 2927.71 | 0.00 | 0.00 | 0.00 | 0.00 | 59.00 | 69.49 | **1691.16** | **2997.20** |
| 52 | ICAR-IGFRI, Jhansi | 250.16 | 269.62 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 75.06 | **250.16** | **344.68** |
| 53 | ICAR-IIMR, Hyderabad | 54.90 | 92.34 | 0.00 | 0.00 | 0.00 | 0.00 | 9.00 | 17.12 | **63.90** | **109.46** |
| 54 | ICAR-IIMR, Ludhiana | 101.68 | 100.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **101.68** | **100.40** |
| 55 | ICAR-IIOR, Hyderabad | 14.86 | 26.94 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **14.86** | **26.94** |
| 56 | ICAR-IIPR, Kanpur | 772.87 | 944.59 | 0.00 | 0.00 | 0.00 | 0.00 | 34.00 | 46.84 | **806.87** | **991.43** |
| 57 | ICAR-IIRR, Hyderabad | 184.05 | 229.80 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **184.05** | **229.80** |
| 58 | ICAR-IISR, Indore | 1125.00 | 1174.60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **1125.00** | **1174.60** |
| 59 | ICAR-NISST, Mau | 0.00 | 247.06 | 205.00 | 191.20 | 0.00 | 0.00 | 75.00 | 91.99 | **280.00** | **530.25** |
| 60 | ICAR-IIWBR, Karnal | 4692.00 | 5826.35 | 0.00 | 0.00 | 0.00 | 0.00 | 2611.00 | 3514.65 | **7303.00** | **9341.00** |
| 61 | ICAR-CRRI, Cuttack | 280.03 | 562.75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **280.03** | **562.75** |
| 62 | ICAR-VPKAS, Almora | 158.39 | 124.89 | 0.00 | 0.00 | 0.00 | 0.00 | 2.80 | 3.69 | **161.19** | **128.58** |
| 63 | ICAR-NEH, Manipur | 85.90 | 129.65 | 10.50 | 10.50 | 40.00 | 51.00 | 0.00 | 0.00 | **136.40** | **191.15** |
| | **Grand Total** | **78022.82** | **116797.95** | **75140.73** | **89665.04** | **62701.29** | **71154.68** | **54776.84** | **65252.29** | **270641.68** | **342869.95** |

**Table 2.2: Summary of centre-wise quality seed production in farmers' field (Rabi 2024-25 and Kharif 2025)**

**(In quintals)**

| Sl. No | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 1 | AAU, Anand | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 2 | ANGRAU, Guntur | 0.00 | 0.00 | 5530.00 | 4607.83 | 1900.00 | 1684.58 | 680.00 | 648.75 | **8110.00** | **6941.16** |
| 3 | AU, Kota | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 4 | BAU, Ranchi | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 5 | BAU, Sabour | 0.00 | 0.00 | 3435.00 | 2431.09 | 1040.00 | 790.49 | 0.00 | 0.00 | **4475.00** | **3221.58** |
| 6 | BCKV, Mohanpur | 0.00 | 0.00 | 0.00 | 0.00 | 394.00 | 402.20 | 568.00 | 595.50 | **962.00** | **997.70** |
| 7 | BHU, Varanasi | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 8 | BSKKV, Dapoli | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1750.50 | 1869.42 | **1750.50** | **1869.42** |
| 9 | CCSHAU, Hisar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 10 | CSAUAT, Kanpur | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 11 | CSKHPKV, Palampur | 0.00 | 0.00 | 0.00 | 0.00 | 90.00 | 118.00 | 6439.50 | 6799.65 | **6529.50** | **6917.65** |
| 12 | GBPUAT, Pantnagar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 13 | IGKV, Raipur | 0.00 | 0.00 | 0.00 | 23761.97 | 0.00 | 35203.88 | 0.00 | 0.00 | **0.00** | **58965.85** |
| 14 | JAU, Junagadh | 0.00 | 0.00 | 0.00 | 472.00 | 3333.33 | 2591.10 | 3750.00 | 6926.00 | **7083.33** | **9989.10** |
| 15 | JNKVV, Jabalpur | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 16 | KAU, Thrissur | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 740.00 | 839.07 | **740.00** | **839.07** |
| 17 | MPKV, Rahuri | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 18 | MPUAT, Udaipur | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 19 | NAU, Navsari | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 20 | NDUAT, Ayodhya | 0.00 | 0.00 | 100.00 | 110.00 | 720.00 | 823.00 | 1018.00 | 1097.00 | **1838.00** | **2030.00** |
| 21 | RLBCAU, Jhansi | 0.00 | 0.00 | 1718.00 | 2070.94 | 120.00 | 245.68 | 0.00 | 120.00 | **1838.00** | **2436.62** |
| 22 | BUAT, Banda | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |

| Sl. No | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 23 | OUAT, Bhubaneswar | 0.00 | 0.00 | 169.00 | 196.50 | 105.00 | 110.81 | 326.00 | 341.80 | **600.00** | **649.11** |
| 24 | PAJANCOA&RI, Karaikal | 0.00 | 0.00 | 208.00 | 243.00 | 0.00 | 0.00 | 0.00 | 0.00 | **208.00** | **243.00** |
| 25 | PAU, Ludhiana | 0.00 | 0.00 | 0.00 | 0.00 | 480.00 | 533.70 | 20.00 | 20.00 | **500.00** | **553.70** |
| 26 | PDKV, Akola | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 27 | PJTSAU, Hyderabad | 0.00 | 0.00 | 5437.00 | 6576.20 | 225.00 | 406.50 | 0.00 | 0.00 | **5662.00** | **6982.70** |
| 28 | RPCAU, Pusa | 0.00 | 0.00 | 10.00 | 6.00 | 3750.00 | 4099.44 | 260.00 | 538.33 | **4020.00** | **4643.77** |
| 29 | RVSKVV, Gwalior | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 30 | SDAU, S.K. Nagar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 31 | SKRAU, Bikaner | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 32 | SKUAST, Jammu | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 33 | SKUASTK, Srinagar | 0.00 | 0.00 | 0.00 | 0.00 | 40.00 | 45.00 | 3107.50 | 3356.00 | **3147.50** | **3401.00** |
| 34 | SVBPUAT, Meerut | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 35 | TNAU, Coimbatore | 0.00 | 0.00 | 1679.00 | 1713.04 | 2166.50 | 4021.23 | 590.15 | 600.65 | **4435.65** | **6334.92** |
| 36 | UAHS, Shimoga | 0.00 | 0.00 | 0.00 | 0.00 | 3710.00 | 4002.25 | 0.00 | 0.00 | **3710.00** | **4002.25** |
| 37 | UAS, Bangalore | 0.00 | 0.00 | 138.00 | 87.00 | 5744.00 | 5987.40 | 814.14 | 739.50 | **6696.14** | **6813.90** |
| 38 | UAS, Dharwad | 0.00 | 0.00 | 1135.00 | 1301.70 | 14486.00 | 13717.20 | 98.00 | 109.00 | **15719.00** | **15127.90** |
| 39 | UAS, Raichur | 0.00 | 0.00 | 1954.00 | 2127.00 | 5319.00 | 5891.00 | 20.50 | 15.25 | **7293.50** | **8033.25** |
| 40 | UBKV, Pundibari | 0.00 | 0.00 | 0.00 | 0.00 | 1130.00 | 1140.00 | 5780.00 | 35062.00 | **6910.00** | **36202.00** |
| 41 | VNMKV, Parbhani | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 42 | AAU, Jorhat | 0.00 | 0.00 | 330.00 | 2564.30 | 155.00 | 594.00 | 0.00 | 0.00 | **485.00** | **3158.30** |
| 43 | CAU, Imphal | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 44 | ICAR-CAZRI, Jodhpur | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 45 | ICAR-CCARI, Goa | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 120.00 | 128.00 | **120.00** | **128.00** |

| Sl. No | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 46 | ICAR-CIARI, Port Blair | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 30.50 | 30.52 | **30.50** | **30.52** |
| 47 | ICAR-CICR, Nagpur | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.00 | 10.00 | **5.00** | **10.00** |
| 48 | ICAR-CRIJAF, Barrackpore | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 49 | ICAR-IIGR, Junagadh | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6090.46 | **0.00** | **6090.46** |
| 50 | ICAR-IIRMR, Bharathpur | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 51 | ICAR-IARI, New Delhi | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 10784.50 | 10910.62 | **10784.50** | **10910.62** |
| 52 | ICAR-IGFRI, Jhansi | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 53 | ICAR-IIMR, Hyderabad | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 111.00 | 176.00 | **111.00** | **176.00** |
| 54 | ICAR-IIMR, Ludhiana | 0.00 | 0.00 | 0.00 | 0.00 | 189.50 | 190.92 | 0.00 | 0.00 | **189.50** | **190.92** |
| 55 | ICAR-IIOR, Hyderabad | 0.00 | 0.00 | 0.00 | 0.00 | 323.00 | 339.30 | 20.00 | 20.98 | **343.00** | **360.28** |
| 56 | ICAR-IIPR, Kanpur | 0.00 | 0.00 | 810.00 | 1447.33 | 575.00 | 858.10 | 25.00 | 84.70 | **1410.00** | **2390.13** |
| 57 | ICAR-IIRR, Hyderabad | 0.00 | 0.00 | 254.70 | 254.70 | 0.00 | 0.00 | 138.75 | 138.75 | **393.45** | **393.45** |
| 58 | ICAR-IISR, Indore | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 202.00 | 225.70 | **202.00** | **225.70** |
| 59 | ICAR-NISST, Mau | 0.00 | 0.00 | 1040.00 | 1257.57 | 2132.00 | 2260.21 | 50.00 | 54.40 | **3222.00** | **3572.18** |
| 60 | ICAR-IIWBR, Karnal | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| 61 | ICAR-CRRI, Cuttack | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 870.00 | 923.00 | **870.00** | **923.00** |
| 62 | ICAR-VPKAS, Almora | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 290.00 | 167.22 | **290.00** | **167.22** |
| 63 | ICAR-NEH, Manipur | 0.00 | 0.00 | 465.00 | 625.78 | 3293.00 | 3905.50 | 3116.40 | 3311.30 | **6874.40** | **7842.58** |
| | **Grand Total** | **0.00** | **0.00** | **24412.70** | **51853.95** | **51420.33** | **89961.49** | **41725.44** | **81949.57** | **117558.47** | **223765.01** |

**Table 2.3: Summary of centre-wise total quality seed production (Rabi 2024-25 and Kharif 2025)**

**(In quintals)**

| Sl. No | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 1 | AAU, Anand | 990.29 | 1293.23 | 225.00 | 243.80 | 2270.00 | 2376.80 | 1316.00 | 1538.28 | **4801.29** | **5452.11** |
| 2 | ANGRAU, Guntur | 9763.56 | 8027.52 | 14524.50 | 14740.01 | 3453.00 | 3158.65 | 1697.50 | 1617.76 | **29438.56** | **27543.94** |
| 3 | AU, Kota | 588.89 | 466.10 | 0.00 | 0.00 | 0.00 | 0.00 | 3675.00 | 3815.90 | **4263.89** | **4282.00** |
| 4 | BAU, Ranchi | 74.50 | 157.02 | 1002.00 | 1072.47 | 0.00 | 0.00 | 0.00 | 0.00 | **1076.50** | **1229.49** |
| 5 | BAU, Sabour | 850.49 | 858.90 | 7880.00 | 8886.54 | 3362.50 | 2641.34 | 53.00 | 175.34 | **12145.99** | **12562.12** |
| 6 | BCKV, Mohanpur | 52.67 | 64.62 | 373.30 | 398.80 | 1987.50 | 2156.20 | 1139.20 | 1232.50 | **3552.67** | **3852.12** |
| 7 | BHU, Varanasi | 120.30 | 186.95 | 662.90 | 688.92 | 1280.10 | 1314.80 | 2462.30 | 2515.80 | **4525.60** | **4706.47** |
| 8 | BSKKV, Dapoli | 61.10 | 149.79 | 89.40 | 140.88 | 120.00 | 147.24 | 2481.40 | 2637.95 | **2751.90** | **3075.86** |
| 9 | CCSHAU, Hisar | 1107.55 | 1939.99 | 2522.00 | 2542.74 | 3936.00 | 3976.38 | 4718.00 | 4471.71 | **12283.55** | **12930.82** |
| 10 | CSAUAT, Kanpur | 203.95 | 1098.48 | 261.20 | 342.94 | 0.00 | 0.00 | 0.00 | 1369.63 | **465.15** | **2811.05** |
| 11 | CSKHPKV, Palampur | 358.10 | 373.59 | 293.70 | 322.69 | 96.35 | 118.35 | 6483.10 | 6844.19 | **7231.25** | **7658.82** |
| 12 | GBPUAT, Pantnagar | 453.40 | 6869.90 | 0.00 | 0.00 | 0.00 | 156.00 | 0.00 | 499.29 | **453.40** | **7525.19** |
| 13 | IGKV, Raipur | 1408.72 | 1755.28 | 0.00 | 32733.22 | 0.00 | 39297.12 | 0.00 | 0.00 | **1408.72** | **73785.62** |
| 14 | JAU, Junagadh | 9346.57 | 9314.62 | 1905.30 | 3002.55 | 3348.33 | 3751.20 | 6373.00 | 10464.85 | **20973.20** | **26533.22** |
| 15 | JNKVV, Jabalpur | 3202.87 | 9900.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **3202.87** | **9900.16** |
| 16 | KAU, Thrissur | 30.55 | 32.50 | 0.00 | 0.00 | 0.00 | 0.00 | 953.36 | 1064.24 | **983.91** | **1096.74** |
| 17 | MPKV, Rahuri | 2642.80 | 5961.26 | 60.00 | 70.36 | 450.00 | 366.00 | 1015.55 | 1225.15 | **4168.35** | **7622.77** |
| 18 | MPUAT, Udaipur | 475.13 | 442.53 | 670.00 | 675.20 | 2885.00 | 2943.28 | 0.00 | 0.00 | **4030.13** | **4061.01** |
| 19 | NAU, Navsari | 112.56 | 226.25 | 267.73 | 286.68 | 696.54 | 742.77 | 2174.11 | 2294.43 | **3250.94** | **3550.13** |
| 20 | NDUAT, Ayodhya | 425.00 | 472.74 | 7554.50 | 7908.19 | 2242.00 | 2364.20 | 1018.00 | 1097.00 | **11239.50** | **11842.13** |
| 21 | RLBCAU, Jhansi | 0.00 | 45.40 | 1918.00 | 2343.79 | 220.00 | 378.68 | 0.00 | 126.80 | **2138.00** | **2894.67** |
| 22 | BUAT, Banda | 0.00 | 104.50 | 235.00 | 315.33 | 0.00 | 0.00 | 15.00 | 27.80 | **250.00** | **447.63** |

| Sl. No | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 23 | OUAT, Bhubaneswar | 374.77 | 325.00 | 6405.00 | 6499.97 | 283.50 | 293.91 | 392.74 | 410.15 | **7456.01** | **7529.03** |
| 24 | PAJANCOA&RI, Karaikal | 9.00 | 9.15 | 237.00 | 275.10 | 0.00 | 0.00 | 6.00 | 15.50 | **252.00** | **299.75** |
| 25 | PAU, Ludhiana | 1550.85 | 4091.45 | 11426.50 | 11690.00 | 28590.00 | 29492.50 | 18519.20 | 19026.75 | **60086.55** | **64300.70** |
| 26 | PDKV, Akola | 4077.89 | 13324.79 | 105.00 | 120.57 | 1506.20 | 1832.00 | 1107.00 | 1337.17 | **6796.09** | **16614.53** |
| 27 | PJTSAU, Hyderabad | 1068.00 | 1282.95 | 5506.00 | 6654.20 | 225.00 | 406.50 | 0.00 | 0.00 | **6799.00** | **8343.65** |
| 28 | RPCAU, Pusa | 1191.99 | 755.23 | 3466.50 | 3406.74 | 5159.60 | 6164.08 | 633.60 | 958.79 | **10451.69** | **11284.84** |
| 29 | RVSKVV, Gwalior | 5220.50 | 4723.98 | 0.00 | 0.00 | 0.00 | 0.00 | 1535.00 | 1690.00 | **6755.50** | **6413.98** |
| 30 | SDAU, S.K. Nagar | 4116.59 | 5394.20 | 0.00 | 84.18 | 0.00 | 123.45 | 0.00 | 1077.01 | **4116.59** | **6678.84** |
| 31 | SKRAU, Bikaner | 928.11 | 1021.85 | 491.50 | 507.03 | 1682.00 | 1741.83 | 1038.00 | 1099.70 | **4139.61** | **4370.41** |
| 32 | SKUAST, Jammu | 316.96 | 275.02 | 1200.00 | 982.03 | 0.00 | 0.00 | 0.00 | 151.20 | **1516.96** | **1408.25** |
| 33 | SKUASTK, Srinagar | 116.51 | 233.39 | 756.00 | 833.50 | 115.00 | 125.00 | 3680.50 | 4051.98 | **4668.01** | **5243.87** |
| 34 | SVBPUAT, Meerut | 288.00 | 428.43 | 2323.00 | 2181.81 | 120.00 | 186.43 | 221.00 | 313.79 | **2952.00** | **3110.46** |
| 35 | TNAU, Coimbatore | 2364.81 | 2522.17 | 7567.50 | 5227.83 | 2438.50 | 4296.23 | 6983.88 | 7333.23 | **19354.69** | **19379.46** |
| 36 | UAHS, Shimoga | 266.15 | 172.14 | 216.00 | 258.25 | 6382.00 | 6551.25 | 0.00 | 0.00 | **6864.15** | **6981.64** |
| 37 | UAS, Bangalore | 953.30 | 1188.11 | 491.00 | 472.21 | 6198.00 | 6910.20 | 970.64 | 899.95 | **8612.94** | **9470.47** |
| 38 | UAS, Dharwad | 4601.34 | 6542.55 | 12256.00 | 14295.70 | 17812.00 | 17174.80 | 218.00 | 229.00 | **34887.34** | **38242.05** |
| 39 | UAS, Raichur | 625.75 | 830.60 | 2501.00 | 2621.00 | 6229.00 | 6763.00 | 144.50 | 254.25 | **9500.25** | **10468.85** |
| 40 | UBKV, Pundibari | 23.65 | 35.10 | 200.00 | 200.00 | 2490.00 | 2480.00 | 6460.00 | 35734.50 | **9173.65** | **38449.60** |
| 41 | VNMKV, Parbhani | 1353.68 | 1937.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2020.34 | **1353.68** | **3958.08** |
| 42 | AAU, Jorhat | 159.65 | 553.77 | 1175.70 | 4706.68 | 1169.50 | 2141.48 | 81.75 | 421.36 | **2586.60** | **7823.29** |
| 43 | CAU, Imphal | 0.00 | 12.85 | 0.00 | 0.00 | 500.00 | 587.86 | 0.00 | 0.00 | **500.00** | **600.71** |
| 44 | ICAR-CAZRI, Jodhpur | 19.20 | 35.56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 611.95 | **19.20** | **647.51** |
| 45 | ICAR-CCARI, Goa | 31.00 | 25.70 | 0.00 | 0.00 | 0.00 | 0.00 | 120.50 | 128.50 | **151.50** | **154.20** |

| Sl. No | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 46 | ICAR-CIARI, Port Blair | 4.45 | 5.20 | 0.00 | 0.00 | 0.00 | 0.00 | 34.00 | 34.67 | **38.45** | **39.87** |
| 47 | ICAR-CICR, Nagpur | 25.50 | 44.43 | 0.00 | 0.00 | 21.50 | 30.10 | 35.00 | 50.00 | **82.00** | **124.53** |
| 48 | ICAR-CRIJAF, Barrackpore | 42.10 | 20.80 | 0.00 | 0.00 | 300.00 | 321.50 | 348.00 | 411.48 | **690.10** | **753.78** |
| 49 | ICAR-IIGR, Junagadh | 6656.19 | 8558.85 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6090.46 | **6656.19** | **14649.31** |
| 50 | ICAR-IIRMR, Bharathpur | 15.89 | 48.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **15.89** | **48.90** |
| 51 | ICAR-IARI, New Delhi | 1632.16 | 2927.71 | 0.00 | 0.00 | 0.00 | 0.00 | 10843.50 | 10980.11 | **12475.66** | **13907.82** |
| 52 | ICAR-IGFRI, Jhansi | 250.16 | 269.62 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 75.06 | **250.16** | **344.68** |
| 53 | ICAR-IIMR, Hyderabad | 54.90 | 92.34 | 0.00 | 0.00 | 0.00 | 0.00 | 120.00 | 193.12 | **174.90** | **285.46** |
| 54 | ICAR-IIMR, Ludhiana | 101.68 | 100.40 | 0.00 | 0.00 | 189.50 | 190.92 | 0.00 | 0.00 | **291.18** | **291.32** |
| 55 | ICAR-IIOR, Hyderabad | 14.86 | 26.94 | 0.00 | 0.00 | 323.00 | 339.30 | 20.00 | 20.98 | **357.86** | **387.22** |
| 56 | ICAR-IIPR, Kanpur | 772.87 | 944.59 | 810.00 | 1447.33 | 575.00 | 858.10 | 59.00 | 131.54 | **2216.87** | **3381.56** |
| 57 | ICAR-IIRR, Hyderabad | 184.05 | 229.80 | 254.70 | 254.70 | 0.00 | 0.00 | 138.75 | 138.75 | **577.50** | **623.25** |
| 58 | ICAR-IISR, Indore | 1125.00 | 1174.60 | 0.00 | 0.00 | 0.00 | 0.00 | 202.00 | 225.70 | **1327.00** | **1400.30** |
| 59 | ICAR-NISST, Mau | 0.00 | 247.06 | 1245.00 | 1448.77 | 2132.00 | 2260.21 | 125.00 | 146.39 | **3502.00** | **4102.43** |
| 60 | ICAR-IIWBR, Karnal | 4692.00 | 5826.35 | 0.00 | 0.00 | 0.00 | 0.00 | 2611.00 | 3514.65 | **7303.00** | **9341.00** |
| 61 | ICAR-CRRI, Cuttack | 280.03 | 562.75 | 0.00 | 0.00 | 0.00 | 0.00 | 870.00 | 923.00 | **1150.03** | **1485.75** |
| 62 | ICAR-VPKAS, Almora | 158.39 | 124.89 | 0.00 | 0.00 | 0.00 | 0.00 | 292.80 | 170.91 | **451.19** | **295.80** |
| 63 | ICAR-NEH, Manipur | 85.90 | 129.65 | 475.50 | 636.28 | 3333.00 | 3956.50 | 3116.40 | 3311.30 | **7010.80** | **8033.73** |
| | **Grand Total** | **78022.82** | **116797.95** | **99553.43** | **141518.99** | **114121.62** | **161116.17** | **96502.28** | **147201.86** | **388200.15** | **566634.96** |

**Table 2.4: Summary of crop-wise total quality seed production (Rabi 2024-25 and Kharif 2025)**

**(In quintals)**

| Sl. No | Commodity/Crops | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |

| A | **Cereal Crops** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Paddy | 8886.40 | 16506.50 | 46550.73 | 80426.76 | 34373.56 | 73181.52 | 39698.89 | 60631.75 | **129509.58** | **230746.54** |
| 2 | Wheat | 16064.91 | 31981.99 | 24117.10 | 28124.00 | 34031.00 | 35461.07 | 30978.60 | 34339.89 | **105191.61** | **129906.95** |
| 3 | Barley | 283.65 | 667.36 | 412.20 | 425.97 | 534.00 | 533.90 | 695.00 | 888.37 | **1924.85** | **2515.60** |
| 4 | Maize | 271.69 | 339.47 | 507.50 | 469.50 | 1389.70 | 1461.67 | 1097.80 | 1249.49 | **3266.69** | **3520.13** |
| 5 | Sorghum | 96.23 | 277.22 | 731.00 | 812.50 | 1285.00 | 1322.00 | 193.20 | 589.25 | **2305.43** | **3000.97** |
| 6 | Pearl millet | 9.85 | 41.92 | 26.00 | 22.50 | 39.00 | 38.10 | 59.50 | 137.04 | **134.35** | **239.56** |
| 7 | Finger millet | 123.53 | 158.09 | 327.20 | 488.21 | 5432.00 | 5981.45 | 482.50 | 578.59 | **6365.23** | **7206.34** |
| 8 | Little millet | 25.37 | 63.46 | 59.00 | 92.89 | 108.00 | 91.80 | 39.54 | 47.29 | **231.91** | **295.44** |
| 9 | Kodo millet | 57.42 | 153.40 | 0.00 | 363.50 | 0.00 | 0.00 | 38.40 | 42.54 | **95.82** | **559.44** |
| 10 | Foxtail millet | 61.44 | 94.88 | 207.00 | 219.50 | 185.00 | 183.17 | 43.85 | 47.74 | **497.29** | **545.29** |
| 11 | Barnyard millet | 38.42 | 56.74 | 48.00 | 49.10 | 150.00 | 136.60 | 44.10 | 56.34 | **280.52** | **298.78** |
| 12 | Browntop millet | 1.02 | 5.00 | 10.00 | 10.00 | 4.00 | 4.00 | 25.00 | 35.28 | **40.02** | **54.28** |
| 13 | Proso millet | 7.78 | 13.62 | 40.00 | 42.00 | 48.00 | 41.60 | 10.80 | 14.73 | **106.58** | **111.95** |
| 14 | Buckwheat | 2.20 | 2.60 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 22.70 | **4.20** | **25.30** |
| 15 | Grain Amaranth | 0.09 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.09** | **0.25** |
| | **Total Cereal Crops** | **25930.00** | **50362.50** | **73035.73** | **111546.43** | **77579.26** | **118436.88** | **73409.18** | **98681.00** | **249954.17** | **379026.81** |
| **B** | **Pulse Crops** | | | | | | | | | | |
| 1 | Chickpea | 7149.48 | 12860.63 | 4904.00 | 6330.67 | 8145.23 | 8098.71 | 3025.15 | 3915.38 | **23223.86** | **31205.39** |
| 2 | Pigeon pea | 564.26 | 979.43 | 3789.00 | 3786.84 | 8432.68 | 9314.56 | 232.45 | 490.13 | **13018.39** | **14570.96** |
| 3 | Mung bean | 826.39 | 890.82 | 1259.80 | 1171.72 | 2906.40 | 3185.24 | 1158.73 | 1560.24 | **6151.32** | **6808.01** |
| 4 | Urd bean | 805.97 | 1276.89 | 2858.90 | 3060.14 | 6197.05 | 9022.71 | 1607.85 | 1612.69 | **11469.77** | **14972.43** |
| 5 | Field pea | 464.40 | 586.66 | 280.60 | 444.48 | 42.50 | 103.41 | 112.00 | 246.80 | **899.50** | **1381.35** |
| 6 | Lentil | 659.45 | 1085.51 | 2514.70 | 1795.75 | 996.50 | 1544.45 | 316.00 | 332.50 | **4486.65** | **4758.21** |
| 7 | Cowpea | 59.56 | 76.81 | 123.15 | 57.59 | 215.00 | 211.00 | 110.52 | 99.88 | **508.23** | **445.28** |
| 8 | Rajmah | 10.06 | 60.83 | 0.00 | 0.00 | 0.00 | 0.00 | 213.40 | 354.18 | **223.46** | **415.01** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | Horse gram | 21.97 | 20.72 | 0.00 | 3.30 | 6.50 | 7.00 | 154.00 | 164.51 | **182.47** | **195.53** |
| 10 | Moth bean | 23.35 | 47.01 | 40.50 | 42.69 | 0.00 | 0.00 | 24.00 | 40.55 | **87.85** | **130.25** |
| 11 | Indian bean | 5.21 | 13.14 | 25.10 | 25.88 | 0.00 | 0.00 | 180.90 | 175.56 | **211.21** | **214.58** |
| 12 | Lathyrus | 92.62 | 107.36 | 25.00 | 32.83 | 15.00 | 20.00 | 13.00 | 23.10 | **145.62** | **183.29** |
| 13 | Cluster bean | 39.55 | 41.58 | 0.00 | 4.75 | 0.00 | 0.00 | 5.15 | 196.53 | **44.70** | **242.86** |
| | **Total Pulse Crops** | **10722.26** | **18047.39** | **15820.75** | **16756.64** | **26956.86** | **31507.08** | **7153.15** | **9212.05** | **60653.02** | **75523.16** |
| **C** | **Oilseed Crops** | | | | | | | | | | |
| 1 | Groundnut | 24533.76 | 23392.73 | 3775.30 | 5118.53 | 2206.50 | 3372.55 | 3116.60 | 12373.34 | **33632.16** | **44257.15** |
| 2 | Soybean | 14760.09 | 21960.17 | 4636.50 | 5359.09 | 4541.00 | 4442.12 | 1132.40 | 2156.04 | **25069.99** | **33917.42** |
| 3 | Sunflower | 43.71 | 73.40 | 0.00 | 0.00 | 212.00 | 216.61 | 26.50 | 31.27 | **282.21** | **321.28** |
| 4 | Safflower | 24.72 | 248.77 | 850.00 | 1060.72 | 690.00 | 674.26 | 130.00 | 371.70 | **1694.72** | **2355.45** |
| 5 | Sesame | 117.70 | 106.51 | 20.30 | 23.24 | 55.50 | 45.43 | 186.92 | 196.12 | **380.42** | **371.30** |
| 6 | Linseed | 112.97 | 182.53 | 142.35 | 154.05 | 67.00 | 108.08 | 140.00 | 243.75 | **462.32** | **688.41** |
| 7 | Niger | 17.31 | 18.84 | 15.00 | 26.82 | 24.50 | 25.88 | 25.17 | 10.17 | **81.98** | **81.71** |
| 8 | Castor | 25.57 | 54.03 | 0.00 | 0.00 | 250.00 | 259.10 | 155.70 | 922.89 | **431.27** | **1236.02** |
| 9 | Indian Mustard | 78.87 | 214.32 | 572.00 | 792.23 | 424.50 | 536.66 | 2644.10 | 14145.12 | **3719.47** | **15688.33** |
| 10 | Toria | 30.52 | 87.54 | 138.00 | 128.46 | 19.00 | 24.20 | 418.50 | 432.11 | **606.02** | **672.31** |
| 11 | Karan Rai | 1.00 | 1.38 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 2.00 | **3.00** | **3.38** |
| 12 | Rai | 31.00 | 178.88 | 0.00 | 7.70 | 0.00 | 330.90 | 325.60 | 310.79 | **356.60** | **828.27** |
| 13 | G. Sarson | 16.35 | 20.95 | 6.00 | 6.66 | 240.00 | 247.60 | 4149.00 | 4319.60 | **4411.35** | **4594.81** |
| 14 | B. Sarson | 1.00 | 1.22 | 0.00 | 0.00 | 40.00 | 45.00 | 72.00 | 77.50 | **113.00** | **123.72** |
| 15 | Y. Sarson | 0.00 | 0.60 | 11.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.41 | **11.00** | **3.01** |
| 16 | Raya | 11.97 | 60.19 | 129.00 | 130.90 | 342.00 | 347.70 | 921.00 | 935.06 | **1403.97** | **1473.85** |
| 17 | Taramira | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.50 | 3.00 | **2.50** | **3.00** |
| | **Total Oilseed Crops** | **39806.54** | **46602.06** | **10295.45** | **12808.40** | **9112.00** | **10676.09** | **13447.99** | **36532.87** | **72661.98** | **106619.42** |
| **D** | **Fiber Crops** | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Cotton | 65.05 | 145.73 | 5.50 | 6.10 | 0.00 | 0.00 | 197.31 | 310.38 | **267.86** | **462.21** |
| 2 | Mesta | 9.40 | 5.70 | 13.00 | 9.80 | 0.00 | 0.00 | 0.00 | 2.00 | **22.40** | **17.50** |
| 3 | Sunnhemp | 15.50 | 8.50 | 175.00 | 179.00 | 36.00 | 45.10 | 600.52 | 539.36 | **827.02** | **771.96** |
| 4 | Jute | 16.62 | 7.17 | 2.00 | 0.60 | 1.50 | 2.20 | 5.00 | 10.50 | **25.12** | **20.47** |
| 5 | Flax | 5.00 | 4.60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **5.00** | **4.60** |
| | **Total Fiber Crops** | **111.57** | **171.70** | **195.50** | **195.50** | **37.50** | **47.30** | **802.83** | **862.24** | **1147.40** | **1276.74** |
| **E** | **Forage Crops** | | | | | | | | | | |
| 1 | F. Bajra | 8.25 | 12.80 | 1.00 | 1.00 | 6.00 | 6.00 | 0.00 | 0.00 | **15.25** | **19.80** |
| 2 | Berseem | 168.53 | 121.05 | 13.00 | 13.32 | 130.00 | 137.70 | 54.00 | 56.20 | **365.53** | **328.27** |
| 3 | F. Cluster bean | 17.63 | 68.40 | 86.00 | 87.35 | 130.00 | 135.72 | 85.00 | 83.62 | **318.63** | **375.09** |
| 4 | F. Cowpea | 21.12 | 20.13 | 0.00 | 0.00 | 0.00 | 0.00 | 2.80 | 3.00 | **23.92** | **23.13** |
| 5 | Dhaincha | 32.00 | 23.00 | 0.00 | 0.00 | 0.00 | 0.00 | 195.42 | 136.07 | **227.42** | **159.07** |
| 6 | Desmanthus | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.70 | 7.15 | **6.70** | **7.15** |
| 7 | F. Maize | 298.30 | 351.65 | 60.00 | 60.00 | 102.00 | 100.00 | 456.00 | 510.58 | **916.30** | **1022.23** |
| 8 | F. Sorghum | 105.31 | 115.37 | 1.00 | 1.50 | 5.00 | 4.10 | 57.00 | 92.50 | **168.31** | **213.47** |
| 9 | Guinea grass | 0.20 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 1.20 | **1.20** | **1.45** |
| 10 | Lucerne | 24.71 | 6.76 | 0.00 | 0.00 | 0.00 | 0.00 | 5.20 | 6.57 | **29.91** | **13.33** |
| 11 | Oats | 772.60 | 888.27 | 45.00 | 48.85 | 60.00 | 62.30 | 747.00 | 926.45 | **1624.60** | **1925.87** |
| 12 | Rye grass | 0.68 | 2.58 | 0.00 | 0.00 | 3.00 | 3.00 | 11.00 | 11.00 | **14.68** | **16.58** |
| 13 | Agathi | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 2.22 | **2.00** | **2.22** |
| 14 | Fenugreek | 1.70 | 2.51 | 0.00 | 0.00 | 0.00 | 0.00 | 20.00 | 31.75 | **21.70** | **34.26** |
| 15 | Amaranthus | 0.04 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 8.31 | 28.54 | **8.35** | **28.60** |
| 16 | Setaria grass | 0.10 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.10** | **0.12** |
| 17 | Tall Fescue | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.65 | 0.80 | **0.65** | **0.80** |
| 18 | Red Clover | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | **0.05** | **0.05** |
| 19 | Rice bean | 1.20 | 1.26 | 0.00 | 0.00 | 0.00 | 0.00 | 7.00 | 6.00 | **8.20** | **7.26** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Dharaf grass | 0.05 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.05** | **0.05** |
| 21 | Napier grass | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 30.00 | 10.00 | **30.00** | **10.00** |
| 22 | Marvel grass | 0.03 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.03** | **0.03** |
| | **Total Forage Crops** | **1452.45** | **1614.29** | **206.00** | **212.02** | **436.00** | **448.82** | **1689.13** | **1913.70** | **3783.58** | **4188.83** |
| | **Grand Total** | **78022.82** | **116797.95** | **99553.43** | **141518.99** | **114121.62** | **161116.17** | **96502.28** | **147201.86** | **388200.15** | **566634.96** |

**Table 2.5: Summary of centre-wise planting material's production (Rabi, 2024-25 and Kharif, 2025)**

| S. No. | Centre | Planting material (q) | | Planting material (lakhs) | | Tissue culture plantlets (lakhs) | |
|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production |
| 1 | AAU, Anand | 0.00 | 0.00 | 4.50 | 2.00 | 0.00 | 0.00 |
| 2 | AAU, Jorhat | 2800.00 | 2088.30 | 1.15 | 3.55 | 0.00 | 0.00 |
| 3 | ANGRAU, Guntur | 5.05 | 5.37 | 9.08 | 8.27 | 0.00 | 0.00 |
| 4 | BSKKV, Dapoli | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.97 |
| 5 | CCS HAU, Hisar | 1650.00 | 1800.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | GBPUAT, Pantnagar | 0.00 | 7158.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | ICAR-IGFRI, Jhansi | 0.00 | 0.00 | 0.00 | 8.50 | 0.00 | 0.00 |
| 8 | IGK, Raipur | 0.00 | 0.00 | 0.00 | 0.00 | 4.00 | 4.00 |
| 9 | ICAR-ISRI, Lucknow | 0.00 | 9740.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | ICAR-JAU, Junagadh | 260.00 | 1638.28 | 0.85 | 1.36 | 0.50 | 0.36 |
| 11 | MPKV, Rahuri | 0.00 | 0.00 | 34.45 | 44.05 | 0.00 | 0.00 |
| 12 | NAU, Navsari | 0.00 | 0.00 | 1.00 | 1.80 | 0.00 | 0.00 |
| 13 | PAU, Ludhiana | 3830.00 | 4693.00 | 0.75 | 0.84 | 0.95 | 1.29 |
| 14 | PJTSAU, Hyderabad | 100.00 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15 | ICAR-SBI, Coimbatore | 0.12 | 0.13 | 3.80 | 3.87 | 0.20 | 0.24 |
| 16 | SKRAU, Bikaner | 0.05 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | TNAU, Coimbatore | 1180.00 | 1249.54 | 14.72 | 14.39 | 0.00 | 0.00 |
| 18 | UAS, Bangalore | 1500.00 | 1400.00 | 4.50 | 1.67 | 2.15 | 1.35 |
| 19 | UAS, Dharwad | 15460.00 | 17840.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | VNMKV, Parbhani | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.43 |
| 21 | VSI, Pune | 0.00 | 0.00 | 110.00 | 115.02 | 1.00 | 3.78 |
| | **Grand Total** | **26785.22** | **47712.66** | **184.80** | **205.33** | **8.80** | **12.42** |

**Note:** Planting material in quintals includes cuttings of sugarcane and forage grasses. While planting material in lakhs consists of single/ two eyed sets of sugarcane and single/ two budded cuttings and root slips of forage grasses. Similarly, tissue culture plantlets in lakhs include tissue culture plantlets of sugarcane.

## Quality seed production during Rabi 2025-26 (Expected)

During Rabi, 2025-26, total expected quality seed production including all classes in various field crops is 334012.39 quintals against the target of 257069.23 quintals. Production comprises 74758.42 quintals of breeder seed, 68298.07 quintals of foundation seed, 132016.63 quintals of certified seeds, 58939.27 quintals of truthfully labelled seed.

**Table 3.1: Summary of centre-wise total quality seed production during Rabi, 2025-26 (Expected)**

**(In quintals)**

| Sl. No. | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 1 | AAU, Anand | 670.06 | 848.65 | 105.00 | 115.00 | 750.00 | 817.00 | 1032.00 | 1182.50 | **2557.06** | **2963.15** |
| 2 | AAU, Jorhat | 30.20 | 45.20 | 411.50 | 266.12 | 651.00 | 1353.60 | 60.70 | 247.95 | **1153.40** | **1912.87** |
| 3 | ANGRAU, Guntur | 5776.15 | 5486.36 | 6885.00 | 6609.00 | 952.00 | 921.00 | 367.00 | 364.00 | **13980.15** | **13380.36** |
| 4 | AU, Kota | 1429.53 | 803.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3740.00 | 3755.00 | **5169.53** | **4558.00** |
| 5 | BAU, Ranchi | 10.18 | 31.80 | 217.00 | 175.00 | 0.00 | 0.00 | 0.00 | 0.00 | **227.18** | **206.80** |
| 6 | BAU, Sabour | 722.50 | 722.50 | 2963.00 | 2963.00 | 5909.60 | 5909.60 | 42.80 | 42.80 | **9637.90** | **9637.90** |
| 7 | BCKV, Mohanpur | 22.60 | 31.20 | 115.00 | 120.00 | 283.00 | 297.00 | 222.00 | 250.00 | **642.60** | **698.20** |
| 8 | BHU, Varanasi | 98.00 | 116.00 | 407.00 | 420.50 | 726.00 | 742.00 | 1374.00 | 1396.00 | **2605.00** | **2674.50** |
| 9 | BSKKV, Dapoli | 31.73 | 59.40 | 0.00 | 0.00 | 0.00 | 0.00 | 90.00 | 119.70 | **121.73** | **179.10** |
| 10 | BUAT, Banda | 3.00 | 15.00 | 0.00 | 455.00 | 0.00 | 0.00 | 350.00 | 290.00 | **353.00** | **760.00** |
| 11 | CAU, Imphal | 0.00 | 0.00 | 0.00 | 0.00 | 160.00 | 0.00 | 0.00 | 0.00 | **160.00** | **0.00** |
| 12 | CCSHAU, Hisar | 944.74 | 1189.85 | 1634.00 | 1688.00 | 21056.00 | 22928.00 | 4976.00 | 5086.00 | **28610.74** | **30891.85** |
| 13 | CSAUAT, Kanpur | 249.41 | 5211.70 | 962.00 | 1065.00 | 0.00 | 0.00 | 0.00 | 0.00 | **1211.41** | **6276.70** |
| 14 | CSKHPKV, Palampur | 101.25 | 162.90 | 576.95 | 692.58 | 132.50 | 173.60 | 1545.50 | 1858.95 | **2356.20** | **2888.03** |
| 15 | GBPUAT, Pantnagar | 416.63 | 5965.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 146.00 | **416.63** | **6111.00** |
| 16 | ICAR-CAZRI, Jodhpur | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 40.00 | 50.00 | **40.00** | **50.00** |

| Sl. No. | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 17 | ICAR-CCARI, Goa | 5.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 15.00 | 0.00 | **20.00** | **0.00** |
| 18 | ICAR-CIARI, Port Blair | 1.45 | 1.65 | 0.00 | 0.00 | 0.00 | 0.00 | 5.00 | 5.50 | **6.45** | **7.15** |
| 19 | ICAR-CICR, Nagpur | 0.00 | 1.00 | 0.00 | 0.00 | 29.00 | 42.00 | 0.00 | 0.00 | **29.00** | **43.00** |
| 20 | ICAR-CRIJAF, Barrackpore | 10.00 | 10.00 | 10.00 | 10.00 | 5.00 | 8.00 | 3.00 | 5.50 | **28.00** | **33.50** |
| 21 | ICAR-CRRI, Cuttack | 88.95 | 182.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **88.95** | **182.30** |
| 22 | ICAR-IARI, New Delhi | 1578.46 | 3129.52 | 0.00 | 0.00 | 0.00 | 0.00 | 4117.00 | 4400.00 | **5695.46** | **7529.52** |
| 23 | ICAR-IGFRI, Jhansi | 166.45 | 299.36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 89.25 | **166.45** | **388.61** |
| 24 | ICAR-IIGR, Junagadh | 0.00 | 115.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **115.00** |
| 25 | ICAR-IIMR, Hyderabad | 40.46 | 42.90 | 0.00 | 0.00 | 0.00 | 0.00 | 222.00 | 416.00 | **262.46** | **458.90** |
| 26 | ICAR-IIMR, Ludhiana | 92.50 | 82.00 | 40.00 | 35.00 | 31100.00 | 29315.00 | 0.00 | 0.00 | **31232.50** | **29432.00** |
| 27 | ICAR-IIOR, Hyderabad | 31.70 | 46.00 | 0.00 | 0.00 | 804.00 | 905.00 | 0.00 | 0.00 | **835.70** | **951.00** |
| 28 | ICAR-IIPR, Kanpur | 1019.04 | 1027.15 | 575.00 | 720.00 | 200.00 | 290.00 | 0.00 | 0.00 | **1794.04** | **2037.15** |
| 29 | ICAR-IIRMR, Bharatpur | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1235.00 | 1410.00 | **1235.00** | **1410.00** |
| 30 | ICAR-IIRR, Hyderabad | 127.25 | 131.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **127.25** | **131.45** |
| 31 | ICAR-IIWBR, Karnal | 4464.00 | 7820.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2190.00 | 3022.00 | **6654.00** | **10842.00** |
| 32 | ICAR-NISST, Mau | 247.00 | 300.00 | 1870.00 | 2070.00 | 0.00 | 0.00 | 110.00 | 110.00 | **2227.00** | **2480.00** |
| 33 | ICAR-RC NEH, Manipur | 18.93 | 17.93 | 50.00 | 100.00 | 462.00 | 513.50 | 1082.20 | 512.00 | **1613.13** | **1143.43** |
| 34 | ICAR-VPKAS, Almora | 86.00 | 85.50 | 0.00 | 0.00 | 0.00 | 0.00 | 385.00 | 385.00 | **471.00** | **470.50** |
| 35 | IGKV, Raipur | 775.73 | 1230.60 | 0.00 | 12658.90 | 0.00 | 25401.20 | 0.00 | 30.00 | **775.73** | **39320.70** |
| 36 | JAU, Junagadh | 579.00 | 762.00 | 65.00 | 144.00 | 2530.00 | 1710.00 | 2135.00 | 3087.40 | **5309.00** | **5703.40** |
| 37 | JNKVV, Jabalpur | 976.60 | 9270.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **976.60** | **9270.20** |
| 38 | KAU, Thrissur | 73.90 | 73.90 | 0.00 | 0.00 | 0.00 | 0.00 | 750.10 | 950.10 | **824.00** | **1024.00** |
| 39 | MPKV, Rahuri | 1200.70 | 2008.19 | 50.00 | 53.50 | 550.00 | 587.88 | 740.00 | 1030.20 | **2540.70** | **3679.77** |

| Sl. No. | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 40 | MPUAT, Udaipur | 51.00 | 51.00 | 230.00 | 230.00 | 1975.00 | 1975.00 | 7.00 | 7.00 | **2263.00** | **2263.00** |
| 41 | NAU, Navsari | 46.38 | 144.54 | 12.65 | 15.90 | 13.10 | 16.00 | 404.98 | 435.50 | **477.11** | **611.94** |
| 42 | NDUAT, Ayodhya | 638.00 | 680.00 | 5995.00 | 6198.00 | 1464.00 | 1524.00 | 750.00 | 792.00 | **8847.00** | **9194.00** |
| 43 | OUAT, Bhubaneswar | 84.30 | 80.70 | 879.00 | 617.50 | 232.00 | 146.80 | 364.50 | 363.50 | **1559.80** | **1208.50** |
| 44 | PAJANCOA&RI, Karaikal | 21.00 | 26.50 | 457.00 | 536.00 | 125.00 | 150.00 | 16.00 | 20.00 | **619.00** | **732.50** |
| 45 | PAU, Ludhiana | 2706.90 | 3941.50 | 2764.00 | 2885.00 | 15646.00 | 16276.00 | 14622.00 | 14871.00 | **35738.90** | **37973.50** |
| 46 | PDKV, Akola | 934.43 | 8068.23 | 1305.50 | 1823.00 | 642.70 | 705.60 | 107.05 | 141.50 | **2989.68** | **10738.33** |
| 47 | PJTSAU, Hyderabad | 821.37 | 1253.15 | 7044.50 | 8012.50 | 832.00 | 924.00 | 0.00 | 0.00 | **8697.87** | **10189.65** |
| 48 | RLBCAU, Jhansi | 0.00 | 0.00 | 460.00 | 3140.00 | 0.00 | 650.00 | 0.00 | 0.00 | **460.00** | **3790.00** |
| 49 | RPCAU, Pusa | 891.00 | 0.00 | 2839.40 | 0.00 | 7360.80 | 0.00 | 1340.90 | 0.00 | **12432.10** | **0.00** |
| 50 | RVSKVV, Gwalior | 4641.50 | 3876.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3148.00 | 2435.00 | **7789.50** | **6311.00** |
| 51 | SDAU, S. K. Nagar | 1805.33 | 2119.76 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **1805.33** | **2119.76** |
| 52 | SKRAU, Bikaner | 920.20 | 1203.20 | 601.00 | 446.00 | 1355.00 | 1367.00 | 762.00 | 760.00 | **3638.20** | **3776.20** |
| 53 | SKUAST, Jammu | 365.25 | 498.25 | 1000.00 | 1400.00 | 0.00 | 0.00 | 0.00 | 0.00 | **1365.25** | **1898.25** |
| 54 | SKUAST, Srinagar | 53.25 | 154.40 | 35.00 | 40.00 | 0.00 | 0.00 | 1640.00 | 1914.50 | **1728.25** | **2108.90** |
| 55 | SVBPUAT, Meerut | 175.00 | 160.00 | 1143.00 | 1110.00 | 0.00 | 0.00 | 0.00 | 0.00 | **1318.00** | **1270.00** |
| 56 | TNAU, Coimbatore | 1411.01 | 1422.10 | 3770.00 | 4043.57 | 289.00 | 365.85 | 2632.70 | 2899.16 | **8102.71** | **8730.68** |
| 57 | UAHS, Shimoga | 12.00 | 12.00 | 75.00 | 85.00 | 2260.00 | 2308.00 | 320.00 | 400.00 | **2667.00** | **2805.00** |
| 58 | UAS, Bangalore | 185.24 | 147.33 | 304.00 | 138.00 | 2400.53 | 1809.00 | 745.86 | 222.86 | **3635.63** | **2317.19** |
| 59 | UAS, Dharwad | 1994.07 | 2782.35 | 4041.00 | 4893.00 | 4428.00 | 7082.00 | 456.00 | 1144.00 | **10919.07** | **15901.35** |
| 60 | UAS, Raichur | 641.60 | 727.60 | 1625.00 | 1835.00 | 1270.00 | 1443.00 | 65.00 | 74.00 | **3601.60** | **4079.60** |
| 61 | UBKV, Pundibari | 0.00 | 0.00 | 445.00 | 489.00 | 3360.00 | 3360.00 | 400.00 | 1350.00 | **4205.00** | **5199.00** |
| 62 | VNMKVV, Parbhani | 54.58 | 84.60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 867.40 | **54.58** | **952.00** |

| Sl. No. | Centre | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| | **Grand Total** | **40542.51** | **74758.42** | **51962.50** | **68298.07** | **109953.23** | **132016.63** | **54611.29** | **58939.27** | **257069.53** | **334012.39** |

**Table 3.2: Summary of crop-wise total quality seed production during Rabi, 2025-26 (Expected)**

**(In quintals)**

| Sl. No | Commodity/Crops | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| **A** | **Cereal Crops** | | | | | | | | | | |
| 1 | Paddy | 3490.20 | 3849.30 | 13338.00 | 13839.52 | 468.00 | 561.20 | 2517.00 | 4007.84 | 19813.20 | 22257.86 |
| 2 | Wheat | 17626.31 | 39581.70 | 22361.00 | 31695.60 | 51202.00 | 66845.00 | 36941.30 | 38668.00 | 128130.61 | 176790.30 |
| 3 | Barley | 286.70 | 1153.00 | 115.60 | 93.10 | 1125.00 | 1126.00 | 465.00 | 560.00 | 1992.30 | 2932.10 |
| 4 | Maize | 208.33 | 342.75 | 45.00 | 43.00 | 31330.00 | 29536.00 | 414.50 | 194.50 | 31997.83 | 30116.25 |
| 5 | Sorghum | 100.15 | 205.30 | 435.00 | 580.00 | 570.00 | 690.00 | 221.05 | 605.95 | 1326.20 | 2081.25 |
| 6 | Pearl millet | 2.62 | 3.16 | 0.00 | 0.00 | 10.00 | 18.00 | 19.00 | 19.50 | 31.62 | 40.66 |
| 7 | Finger millet | 16.22 | 16.92 | 84.00 | 43.00 | 2256.53 | 2265.00 | 69.00 | 69.99 | 2425.75 | 2394.91 |
| 8 | Little millet | 0.16 | 7.06 | 0.00 | 0.00 | 0.00 | 0.00 | 10.00 | 10.00 | 10.16 | 17.06 |
| 9 | Kodo millet | 0.15 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 10.00 | 10.00 | 10.15 | 10.15 |
| 10 | Foxtail millet | 0.15 | 17.65 | 15.00 | 0.00 | 0.00 | 0.00 | 126.50 | 140.50 | 141.65 | 158.15 |
| 11 | Barnyard millet | 1.60 | 7.80 | 0.00 | 0.00 | 0.00 | 0.00 | 16.00 | 16.60 | 17.60 | 24.40 |
| 12 | Proso millet | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 10.60 | 0.90 | 10.60 | 0.90 |
| 13 | Buckwheat | 30.54 | 30.54 | 0.00 | 0.00 | 0.00 | 0.00 | 174.00 | 201.00 | 204.54 | 231.54 |
| | **Total Cereal Crops** | **21763.13** | **45215.33** | **36393.60** | **46294.22** | **86961.53** | **101041.20** | **40993.95** | **44504.78** | **186112.21** | **237055.53** |
| **B** | **Pulse Crops** | | | | | | | | | | |
| 1 | Chickpea | 9318.77 | 17255.04 | 5603.30 | 9127.40 | 6660.60 | 11534.70 | 2556.10 | 4385.60 | 24138.77 | 42302.74 |

| Sl. No | Commodity/Crops | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 2 | Pigeon pea | 1.50 | 1.50 | 30.00 | 30.03 | 0.00 | 0.00 | 7.00 | 7.00 | 38.50 | 38.53 |
| 3 | Mung | 196.07 | 161.97 | 1429.00 | 1639.50 | 348.00 | 291.00 | 402.60 | 406.15 | 2375.67 | 2498.62 |
| 4 | Urd | 256.37 | 243.65 | 2257.00 | 2185.05 | 1711.00 | 1691.90 | 245.50 | 244.80 | 4469.87 | 4365.40 |
| 5 | Field Pea | 640.86 | 931.70 | 81.35 | 177.98 | 31.00 | 35.50 | 433.00 | 92.25 | 1186.21 | 1237.43 |
| 6 | Lentil | 1200.15 | 1481.80 | 685.40 | 904.20 | 2357.00 | 2959.00 | 199.00 | 253.95 | 4441.55 | 5598.95 |
| 7 | Cowpea | 30.20 | 50.78 | 100.00 | 116.40 | 85.00 | 160.55 | 43.00 | 34.50 | 258.20 | 362.23 |
| 8 | Rajmah | 56.58 | 45.60 | 0.00 | 0.00 | 0.00 | 0.00 | 5.70 | 7.20 | 62.28 | 52.80 |
| 9 | Horse gram | 2.86 | 3.06 | 0.00 | 0.00 | 0.00 | 0.00 | 71.00 | 68.57 | 73.86 | 71.63 |
| 10 | Moth bean | 0.00 | 0.00 | 20.00 | 26.57 | 0.00 | 0.00 | 23.00 | 23.15 | 43.00 | 49.72 |
| 11 | Field bean | 44.14 | 38.26 | 133.35 | 123.90 | 544.00 | 407.50 | 232.73 | 235.97 | 954.22 | 805.63 |
| 12 | Lathyrus | 95.00 | 136.00 | 35.00 | 999.00 | 36.40 | 1236.50 | 54.80 | 86.80 | 221.20 | 2458.30 |
| 13 | Rice bean | 1.20 | 1.25 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 | 5.00 | 4.20 | 6.25 |
| 14 | Cluster bean | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.50 | 4.20 | 4.50 | 4.20 |
| | **Total Pulse Crops** | **11843.70** | **20350.61** | **10374.40** | **15330.03** | **11773.00** | **18316.65** | **4280.93** | **5855.14** | **38272.03** | **59852.43** |
| **C** | **Oilseed Crops** | | | | | | | | | | |
| 1 | Groundnut | 4678.12 | 4716.30 | 1791.50 | 1806.50 | 1480.00 | 1185.00 | 1504.00 | 988.30 | 9453.62 | 8696.10 |
| 2 | Soybean | 795.20 | 760.27 | 1050.00 | 1300.00 | 1000.00 | 1100.00 | 0.00 | 0.00 | 2845.20 | 3160.27 |
| 3 | Sunflower | 13.70 | 8.70 | 0.00 | 0.00 | 1135.00 | 1155.00 | 7.00 | 7.00 | 1155.70 | 1170.70 |
| 4 | Safflower | 138.60 | 398.65 | 640.00 | 863.50 | 1394.80 | 1724.38 | 0.00 | 317.00 | 2173.40 | 3303.53 |
| 5 | Sesame | 64.97 | 72.72 | 96.00 | 103.00 | 215.00 | 239.00 | 254.93 | 306.68 | 630.90 | 721.40 |
| 6 | Linseed | 186.18 | 487.35 | 25.00 | 364.00 | 356.30 | 292.00 | 57.00 | 134.50 | 624.48 | 1277.85 |
| 7 | Niger | 10.00 | 12.50 | 2.00 | 2.00 | 0.00 | 0.00 | 7.53 | 6.73 | 19.53 | 21.23 |
| 8 | Castor | 2.20 | 2.50 | 10.00 | 10.00 | 30.00 | 30.00 | 20.00 | 20.30 | 62.20 | 62.80 |

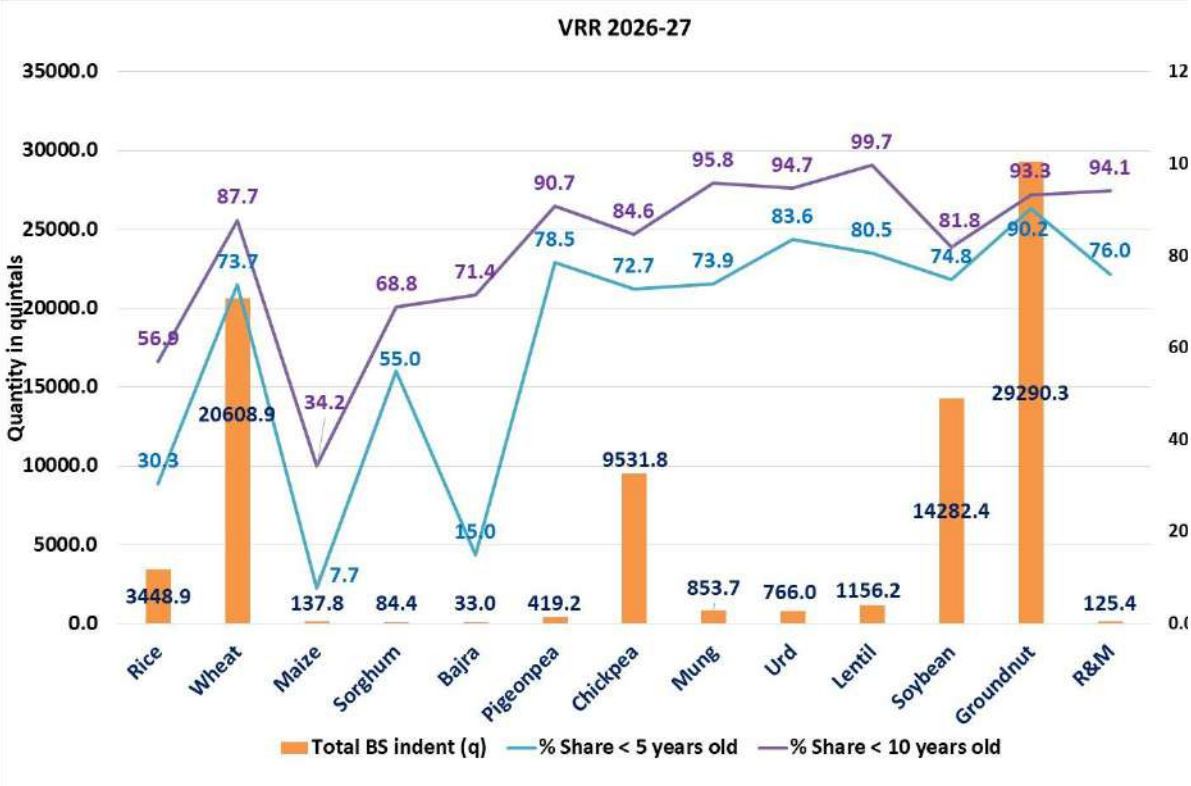
| Sl. No | Commodity/Crops | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 9 | Indian Mustard | 64.78 | 257.78 | 1137.50 | 1764.00 | 4959.60 | 5957.80 | 2584.80 | 3073.30 | 8746.68 | 11052.88 |
| 10 | Toria | 18.45 | 210.25 | 167.50 | 153.92 | 118.00 | 414.60 | 628.00 | 33.10 | 931.95 | 811.87 |
| 11 | Karan Rai | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 200.00 | 225.00 | 200.00 | 225.00 |
| 12 | Rai | 56.98 | 970.90 | 77.00 | 90.00 | 0.00 | 0.00 | 1060.90 | 0.00 | 1194.88 | 1060.90 |
| 13 | G. Sarson | 7.00 | 9.50 | 13.00 | 15.90 | 182.00 | 193.00 | 516.50 | 628.50 | 718.50 | 846.90 |
| 14 | B. Sarson | 1.44 | 2.80 | 35.00 | 40.00 | 0.00 | 0.00 | 108.00 | 115.00 | 144.44 | 157.80 |
| 15 | Y. Sarson | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.00 | 10.00 | 5.00 | 10.00 |
| 16 | Raya | 2.60 | 7.50 | 0.00 | 0.00 | 0.00 | 0.00 | 33.00 | 33.00 | 35.60 | 40.50 |
| 17 | Taramira | 0.00 | 0.00 | 4.00 | 4.00 | 0.00 | 0.00 | 10.00 | 10.00 | 14.00 | 14.00 |
| | **Total Oilseed Crops** | **6040.22** | **7917.72** | **5048.50** | **6516.82** | **10870.70** | **12290.78** | **6996.66** | **5908.41** | **28956.08** | **32633.73** |
| **D** | **Fiber Crops** | | | | | | | | | | |
| 1 | Cotton | 4.21 | 4.30 | 0.00 | 0.00 | 0.00 | 0.00 | 8.00 | 8.40 | 12.21 | 12.70 |
| 2 | Sunnhemp | 0.00 | 3.00 | 5.00 | 5.00 | 20.00 | 20.00 | 775.85 | 811.20 | 800.85 | 839.20 |
| 3 | Flax | 10.00 | 10.00 | 10.00 | 10.00 | 3.00 | 3.00 | 1.00 | 1.00 | 24.00 | 24.00 |
| | **Total Fiber Crops** | **14.21** | **17.30** | **15.00** | **15.00** | **23.00** | **23.00** | **784.85** | **820.60** | **837.06** | **875.90** |
| **E** | **Forage Crops** | | | | | | | | | | |
| 1 | Sesbania | 25.93 | 27.00 | 0.00 | 0.00 | 0.00 | 0.00 | 13.10 | 16.00 | 39.03 | 43.00 |
| 2 | F. Pearl Millet | 5.00 | 6.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.00 | 6.00 |
| 3 | Berseem | 218.90 | 243.45 | 36.00 | 36.00 | 205.00 | 205.00 | 67.00 | 74.75 | 526.90 | 559.20 |
| 4 | F. Cowpea | 3.90 | 2.77 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.12 | 4.00 | 2.89 |
| 5 | Dhaincha | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 139.80 | 138.97 | 139.80 | 138.97 |
| 6 | Desmanthus | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12.20 | 12.20 | 12.20 | 12.20 |
| 7 | F. Maize | 10.50 | 11.30 | 0.00 | 0.00 | 0.00 | 0.00 | 25.00 | 30.97 | 35.50 | 42.27 |

| Sl. No | Commodity/Crops | Breeder seed | | Foundation seed | | Certified seed | | Truthfully labelled seed | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production | Target | Production | Target | Production |
| 8 | F. Sorghum | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 24.70 | 25.00 | 24.70 | 25.00 |
| 9 | Fenugreek | 4.70 | 5.05 | 0.00 | 0.00 | 0.00 | 0.00 | 30.15 | 30.58 | 34.85 | 35.63 |
| 10 | Lucerne | 20.64 | 16.90 | 0.00 | 0.00 | 0.00 | 0.00 | 3.20 | 4.70 | 23.84 | 21.60 |
| 11 | Metha | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 20.00 | 22.00 | 21.00 | 23.00 |
| 12 | Oats | 589.10 | 941.66 | 95.00 | 106.00 | 120.00 | 140.00 | 1193.00 | 1468.00 | 1997.10 | 2655.66 |
| 13 | Rye Grass | 1.50 | 2.25 | 0.00 | 0.00 | 0.00 | 0.00 | 17.00 | 17.00 | 18.50 | 19.25 |
| 14 | Fescue grass | 0.05 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 |
| 15 | Napier grass | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.50 | 0.50 | 0.50 |
| 15 | Amaranthus | 0.03 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 7.65 | 7.65 | 7.68 | 7.68 |
| 16 | Agathi | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.50 | 1.90 | 1.50 | 1.90 |
| | **Total Forage Crops** | **881.25** | **1257.46** | **131.00** | **142.00** | **325.00** | **345.00** | **1554.90** | **1850.34** | **2892.15** | **3594.80** |
| | **Total** | **40542.51** | **74758.42** | **51962.50** | **68298.07** | **109953.23** | **132016.63** | **54611.29** | **58939.27** | **257069.53** | **334012.39** |

## Varietal Replacement Rate (VRR) in major field crops

Varietal Replacement Rate (VRR) is one of the important factors in realizing higher crop productivity. The pace of progress in food production is largely depend upon the progress of seed programme that could able to supply quality seed of high yielding varieties with superior genetics.

**Comparison of Varietal Replacement Rate (VRR) among major field crops**



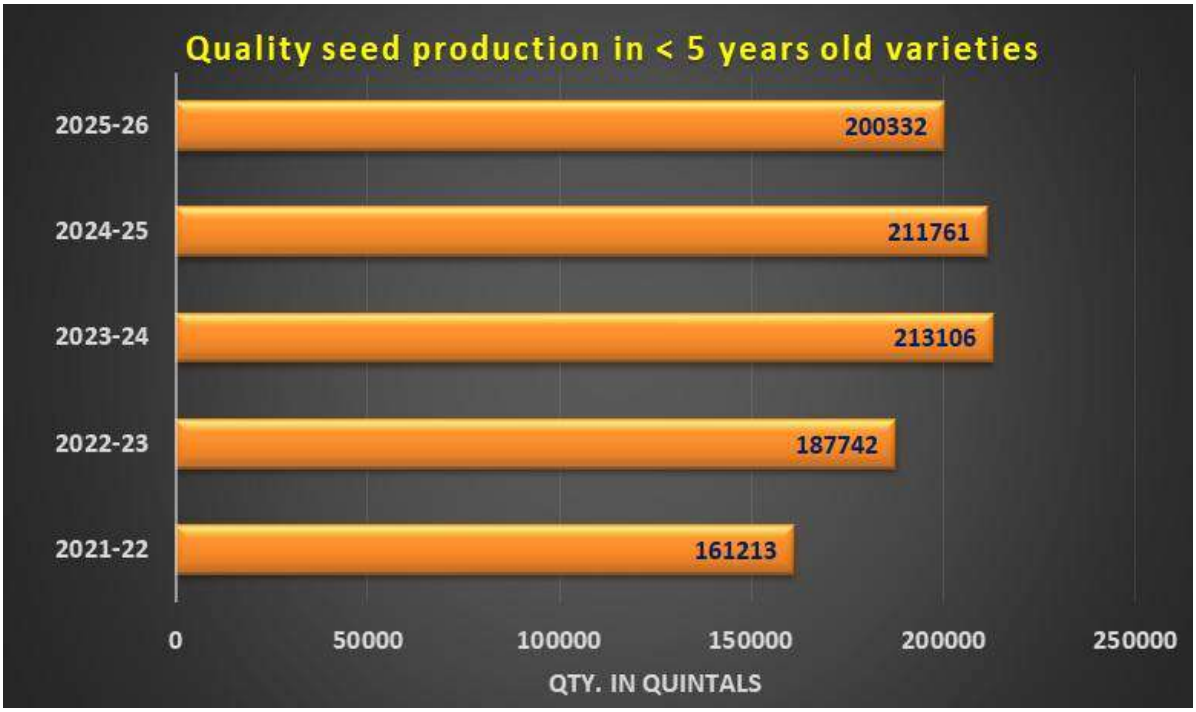

Perusal of breeder seed indents during 2026-27 suggests that, across the crops, there has been a significant enhancement in VRR. In rice, share of varieties, notified during last five years and ten years in total breeder seed indent were 30.3 % and 56.9 % during 2026-27 as compared to 12.8 % and 43.2 % during 2018-19, respectively. Similarly, in wheat, the share of five years and ten years old varieties were 73.7 % and 87.7 % during 2026-27 as compared to 49.4 % and 75.1 % during 2018-19, respectively. Among pulses, pigeon pea had the share of 78.5 % and 90.7 % during 2026-27 as compared to 3.5 % and 36.5 % during 2018-19, respectively. Similarly, lentil had the share of 80.5 % and 99.7 % during 2026-27 as compared to 20.4 % and 53.8 % during 2018-19, respectively, indicating better VRR. In general, pace of VRR among all major field crops were found to be adequate for reaping the benefits of modern crop varieties. Meanwhile, the rationalization of breeder seed indents was also achieved in crops viz. wheat, soybean, groundnut and chickpea.

**Quality seed production in new crop varieties under AICRP on Seed (Crops)**

Varietal Replacement Rate (VRR) is one of the important factors in realizing higher crop productivity. Although discernible progress was made in quality seed production, still some of

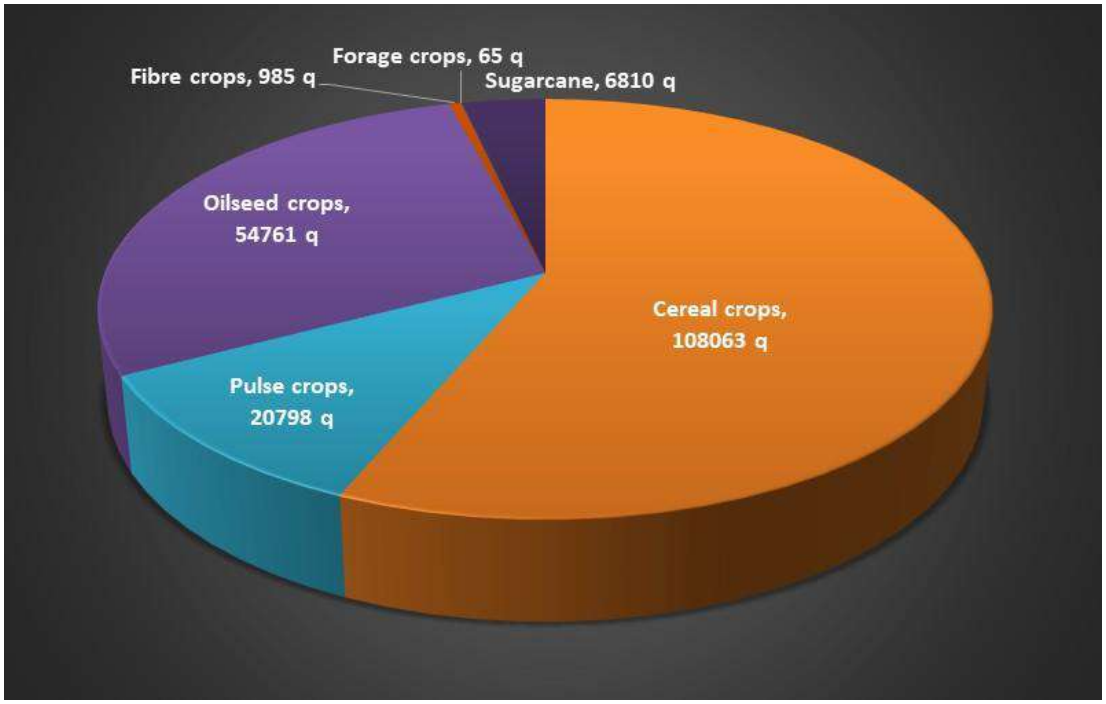
the issues such as Varietal Replacement Rate (VRR) and Seed Replacement Rate (SRR) need to be tackled. Under the ambit of AICRP on Seed (Crops), due emphasis has been given for quality seed production of new crop varieties. In recent years, cooperating centres are promoting large scale seed production of new varieties through farmers participatory seed production programmes. During 2025-26, 200332.0 quintals of quality seed were produced in new varieties under AICRP on Seed (Crops).

**Quality seed production in newly released varieties under AICRP on Seed (Crops) (< 5 years old)**




**Crop-wise quality seed production in new crop varieties under AICRP on Seed (Crops)**

During 2025-26, out of the total quality seed produced in new crop varieties, the major share belongs to cereal crops i.e., 108063 q in which maximum quality seed was produced for wheat (40216q) followed by paddy (39291q). Under pulse crops a total of 20798 q quality seed was produced out of which 10768 q was alone contributed by chickpea followed by pigeon pea (4881 q) and urd bean (2018 q). In oilseeds, total quality seed production was 54761 q; soybean and groundnut together have contributed to 47748 q. Quality seed produced in case of fiber crops was 985 q. In case of forage crops, quality seed production was 65 q, out of which 40 q alone was contributed by oats. In sugarcane, 6810 q of planting material (setts) were also produced.




**Crop-wise quality seed production in new varieties, 2025-26**

# Seed Technology Research Highlights 2025-26

## A. Seed Production and Certification

### Experiment 1: Standardization of isolation distance in mustard hybrids

**Rationale:** The development of CGMS based hybrids in Indian mustard has prompted for undertaking experimentation for working out isolation distance standards and recommend for its inclusion in IMSCS, 2013.

**Objective:** To recommend isolation distance in certified seed production of mustard hybrids

**Centres:** PDKV, Akola, UBKV, Pundibari and ICAR-IARI, Jharkhand. However, the report was submitted only by PDKV, Akola and UBKV, Pundibari, as the experiment was vitiated at ICAR-IARI, Jharkhand.

**Methodology:** A plot size of 2.25 m (width) x 20 m (length) with a spacing of 45 x 15 cm (minimum of 5 rows) was maintained for the pollen parent (Purple mutant). Four rows of female parent (CMS line, MJA1) with 3 m row length each were planted at different distances viz., 600, 700, 800, 900 and 1000 m. Precaution will be taken that no other crop variety of mustard should be grown within a periphery of 1000 m

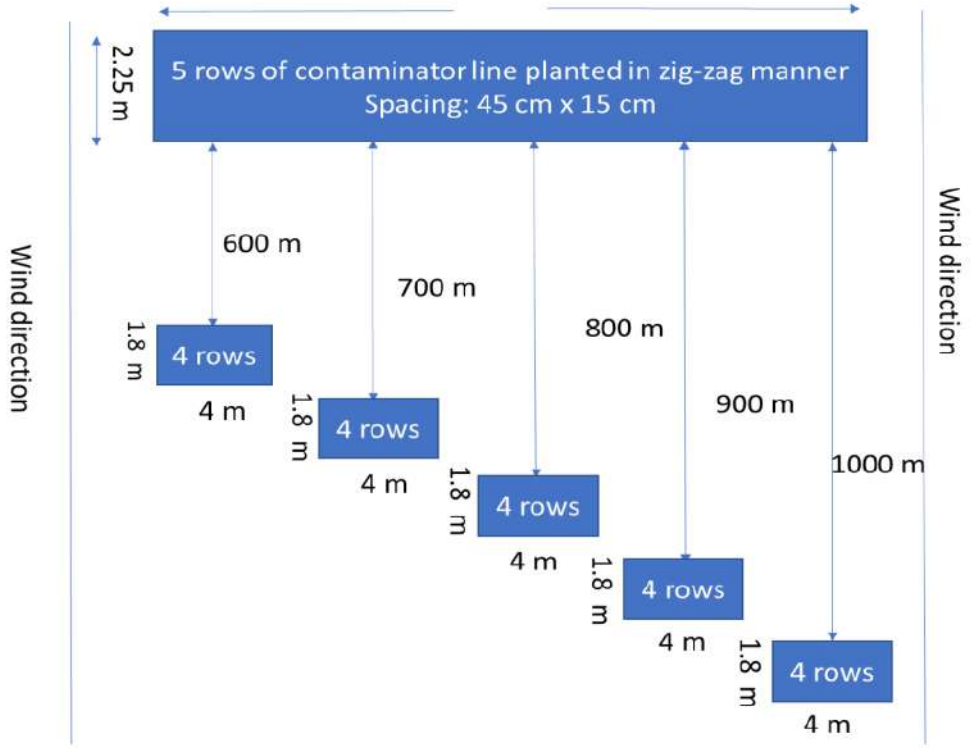



**Fig.1.1: Schematic field layout for standardization of isolation distance in hybrid Mustard**

**Table 1.1: Flowering and seed setting behaviour in parental lines of mustard at PDKV, Akola**

| Isolation distances/ Parental lines | Field emergence (%) | Days to | | Duration of flowering | Extent of selfing in female lines on bagging | Plant height at (cm) | | Seed set (%) | Seed yield / plant (g) | Test weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | First flowering | 50% flowering | | | 30 DAS | Harvest | | | |
| **Pollen parent (Male parent)** | | | | | | | | | | |
| - | 86.00 | 34 | 48 | 32 | - | 38 | 158 | 88 | 17.60 | 2.50 |
| **Female parent (Female parent)** | | | | | | | | | | |
| **D1(600m)** | 74.00 | 44 | 52 | 28 | 10* | 35 | 162 | 76 | 15.22 | 3.40 |
| **D2(700m)** | 70.00 | 40 | 50 | 26 | 10* | 30 | 160 | 73 | 14.22 | 3.40 |
| **D3(800m)** | 76.00 | 44 | 54 | 30 | 20* | 36 | 156 | 75 | 16.00 | 3.42 |
| **D4(900m)** | 63.00 | 42 | 53 | 28 | 20* | 32 | 162 | 74 | 15.68 | 3.39 |
| **D5(1000m)** | 69.00 | 42 | 52 | 30 | 10* | 31 | 155 | 75 | 14.44 | 3.45 |
| **Mean** | **70.40** | **42.40** | **52.20** | **28.40** | **14*** | **32.80** | **159** | **74.60** | **15.11** | **3.41** |

***All remaining plants out of 20 in bagged selfed plants showed rudimentary pods without seed filling**

**Table 1.2: Observations on pollinator activity at different isolation distances in mustard**

| Isolation distances/ Parental lines | Honeybee/other pollinators | | | |
|---|---|---|---|---|
| | Pollen gatherers | | Nectar collectors | |
| | FN | AN | FN | AN |
| | (8-10AM) | (2-4 PM) | (8-10AM) | (2-4 PM) |
| **Pollinator line (Male parent)** | | | | |
| - | Mean no. of pollinators/5min | | Peak foraging (hrs) | |
| - | 7.00 | 14.00 | 12 | 8 |
| **CMS line (Female parent)** | | | | |
| **D1(600m)** | 8.28 | 12.00 | 12 | 10 |
| **D2(700m)** | 6.00 | 12.00 | 12 | 8 |
| **D3(800m)** | 8.20 | 13.00 | 11 | 10 |
| **D4(900m)** | 7.00 | 14.00 | 11 | 11 |
| **D5(1000m)** | 8.30 | 12.00 | 11 | 6 |
| **Mean** | 7.55 | 12.60 | 12.60 | **9** |
| **Name of the Species involved in pollination** | Apis mellifera, Apis florea, Apis Dorsata, Bombus Spp-Bumble bee, *Coccinella septempunctata* | | Apis mellifera, Apis florea, Apis Dorsata, Bombus Spp-Bumble bee, *Coccinella septempunctata* | |

**Note: The data of UBKV, Pundibari was insufficient and hence, not included in the report.**

**Results**: The confirmation of hybridity was carried out on seeds harvested from open-pollinated plants of each block using the morphological purple leaf marker at the seedling stage under laboratory conditions. Out of 1000 seeds tested, one seedling each exhibited the purple leaf trait at isolation distances of 600 m and 700 m, confirming pollen flow

from the R line up to 700 m. Therefore, an isolation distance of 800 m may be considered optimum for hybrid seed production in mustard.




**Fig. 1.1: Maintenance of different isolation distances of CMS line from the pollen parent**




Expression of purple leaf trait at seedlings stage in seeds harvested from R line (Check)



Absence of purple leaf (all green) in seedlings developed from seeds harvested from A line plants (indicating pollen source is B line: as admixture in A line

**Fig. 1.2: Testing of harvested open pollinated seeds in laboratory at Dr. PDKV, Akola**




A line at 600 m isolation distance A line at 700 m isolation distance

1 seedling out of 1000 seeds tested expressed hybridity

**Fig. 1.3: Laboratory testing of harvested seeds for exprerssion of purple leaf trait**

**Experiment 2: Optimization of seed rate for enhancing seed yield and recovery of pure live seed**

**Year of start: 2022-23**

**Objective**: To determine the optimum seed rate for maximizing seed yield and quality

**Crops:** Chickpea and Groundnut

**Chickpea**

| **Treatment Details** | | |
|---|---|---|
| **Treatments** | **Factor 1. Seed rate** ($S_1$to $S_5$): Five different seed rates in each category as mentioned below<br>**Factor 2. Varieties**: Two varieties of respective group as mentioned above<br>Total no. of treatments: 10 | |
| **Replications** | 3 | |
| **Design** | Factorial Randomized Block Design | |
| **Small seeded (100 seed weight: <20g)** | **Medium seeded (100 seed weight: 20-25g)** | **Large seeded (100 seed weight: >25g)** |
| $S_1$: **75 kg/ha** (Recommended Seed Rate/ RSR)- Control | $S_1$: **100 kg/ha** (Recommended Seed Rate/ RSR)- Control | $S_1$: **120 kg/ha** (Recommended Seed rate/ RSR)- Control |
| $S_2$: **67.5 kg/ha** (10% less than RSR) | $S_2$: **90 kg/ha** (10% less than RSR) | $S_2$: **108 kg/ha** (10% less than RSR) |
| $S_3$: **60 kg/ha**(20% less than RSR) | $S_3$: **80 kg/ha**(20% less than RSR) | $S_3$: **96 kg/ha** (20% less than RSR) |
| $S_4$: **52.5 kg/ha**(30% less than RSR) | $S_4$: **70 kg/ha**(30% less than RSR) | $S_4$: **84 kg/ha** (30% less than RSR) |
| $S_5$: **45 kg/ha** (40% less than RSR) | $S_5$: **60 kg/ha**(40% less than RSR) | $S_5$: **72 kg/ha** (40% less than RSR) |

**Unified Observation:** The experiment was conducted during Rabi season 2024-25 at twelve locations viz., UAS, Bengaluru; UAS, Raichur; PJTSAU Hyderabad and MPKV, Rahuri **(Small Seeded);** VNMKV, Parbhani; RARI, Durgapura**;** PDKV, Akola and ICAR-IARI, New Delhi **(Medium Seeded);** CCSHAU, Hisar; PAU, Ludhiana; JNKVV, Jabalpur and ANDUAT, Faizabad **(Bold Seeded)**; to evaluate chickpea varieties for their optimum seed rate for maximizing seed yield and recovery of pure live seed.

**List of chickpea varieties used by different centres**

| Seed Size | Centres | Varieties |
|---|---|---|
| **Small Seeded** | UAS, Bengaluru | Super Annigeri 1 and Phule Vikrant (Phule G0405) |
| | UAS, Raichur | |
| | PJTSAU Hyderabad | |
| | MPKV, Rahuri | |
| **Medium Seeded** | VNMKV, Parbhani | Jaki 9218 and Pusa Parvathi/BG 3043 |
| | RARI, Durgapura | |
| | PDKV, Akola | |
| | ICAR-IARI, New Delhi | |
| | CCSHAU, Hisar | Jawahar Gram 24 and HC-3 |

| | | |
|---|---|---|
| **Bold-seeded** | PAU, Ludhiana | |
| | JNKVV, Jabalpur | |
| | ANDUAT, Faizabad | |

**The detailed mean data over locations is presented below:**

In case of **small seeded varieties**, maximum field emergence (82.4%), plant stand establishment/$m^2$ (28.3), plant height at 30 DAS (30.3 cm) and at harvest (48.2), seed yield (19.95 g/plant, 2.95 kg/plot and 22.17 q/ha), including seed quality attributes viz., germination (94.6 %), 1000 seed weight (232) and seedling vigour index-I (2396). was recorded in S1(Recommended Seed rate - Control). Moreover, the highest net monetary returns (Rs. 181789/-) and BC Ratio (2.82) were also observed in S1. However, the pure live seed was found to be at par with S2. Since, S1 treatment exhibited optimum seed yield, reduction in recommended seed rate is not economical in small seeded chickpea varieties (Fig. 1.4 and 1.5).

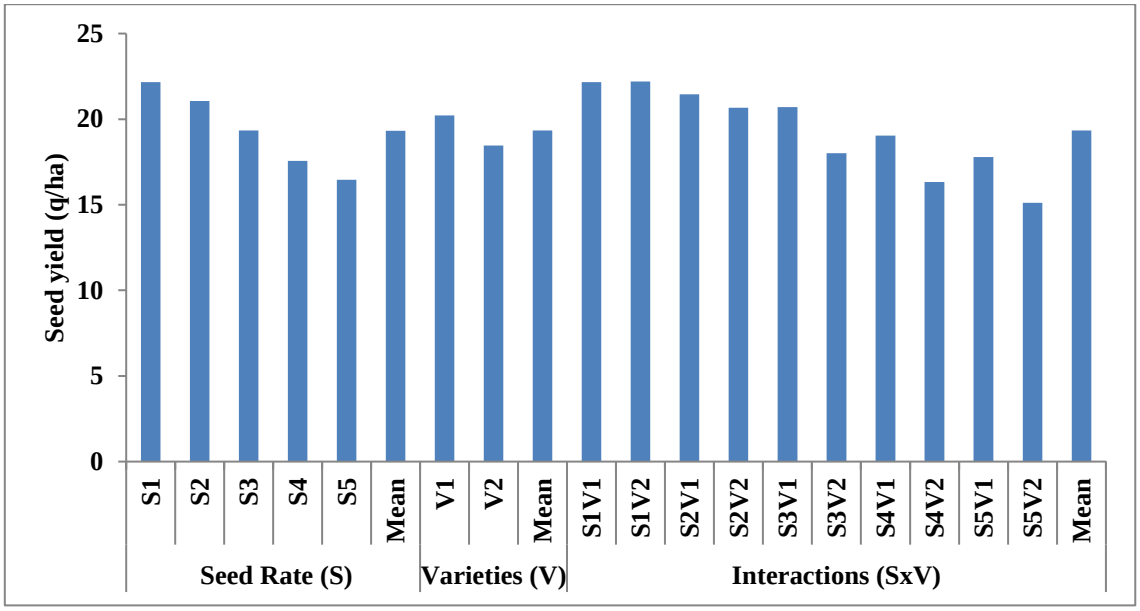



**Fig. 1.4: Effect of differential seed rates on seed yield in chickpea (small seeded)**

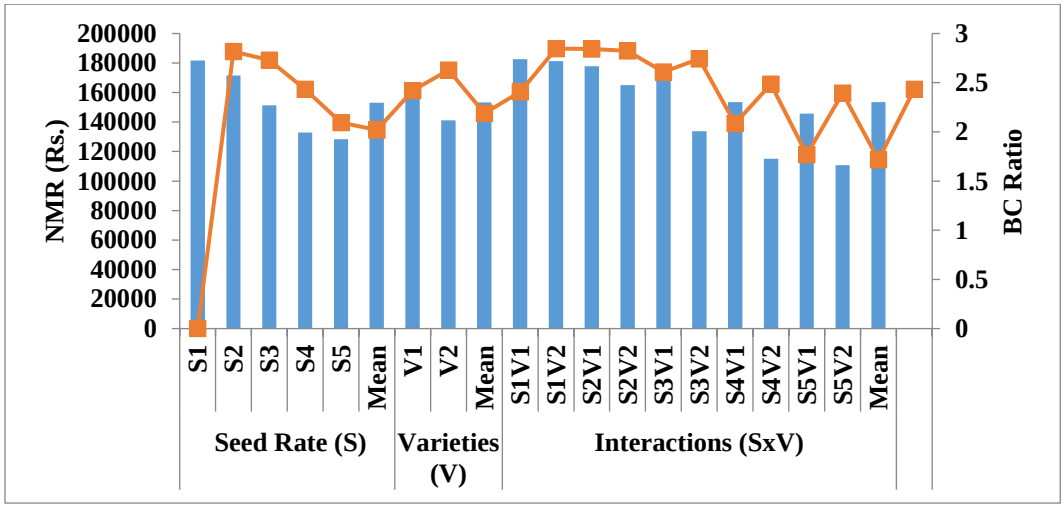



**Fig. 1.5: Effect of differential seed rates on economic indicators in chickpea (small seeded)**

In case of **medium seeded varieties**, field emergence (89.3%), plant stand establishment/$m^2$ (54.8), plant height at harvest (55.6 cm) was found highest in recommended seed rate (S1),whereas S2 (10% less than recommended seed rate) exhibited highest plant height at 30 DAS (21.38 cm), no. of pods/plant (66.67) and seed yield (19.84 g/plant, 2.57 kg/plot and 23.67 q/ha), including seed quality parameters viz. seed germination (93.03%), seedling vigour index I (3114) and pure live seed (91.66%) as well as net monetary returns (116628) and BC ratio (2.40). Hence, S2 (10% less than the recommended seed rate) was found was found to be optimum as compared to the recommended seed rates in case of medium seeded varieties of chickpea (Fig. 1.6 and 1.7).

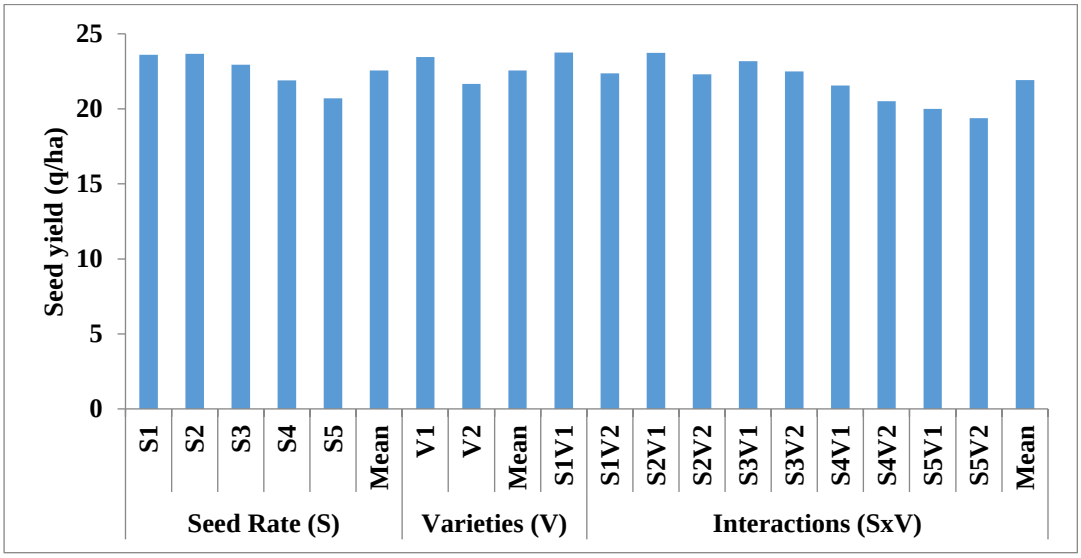



**Fig. 1.6: Effect of differential seed rates on seed yield in chickpea (medium seeded)**

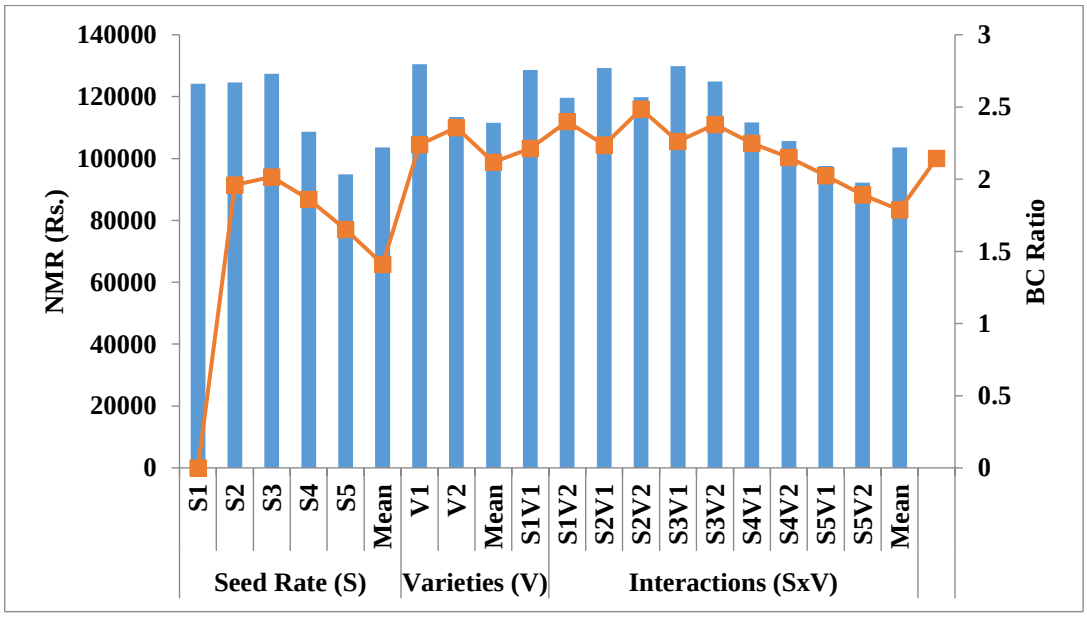



**Fig. 1.7: Effect of differential seed rates on economic indicators in chickpea (medium seeded)**

In case of **large seeded varieties**, maximum field emergence (77.58), plant stand establishment /$m^2$ (31.04), plant height at harvest (65.21 cm) was found to be highest in recommended seed rate (S1). However, the seed yield (2.14 kg/plot and 17.09 q/ha) and seed quality attributes like germination (88.17%), vigor index I (1964), including higher net monetary returns (116173) and BC Ratio (1.88) were found superior in S2 (10% less than recommended seed rate). Hence, S2(10% less than the recommended seed rate) was found to be optimum as compared to the recommended seed rates in case of large seeded varieties of chickpea (Fig. 1.8 and 1.9).

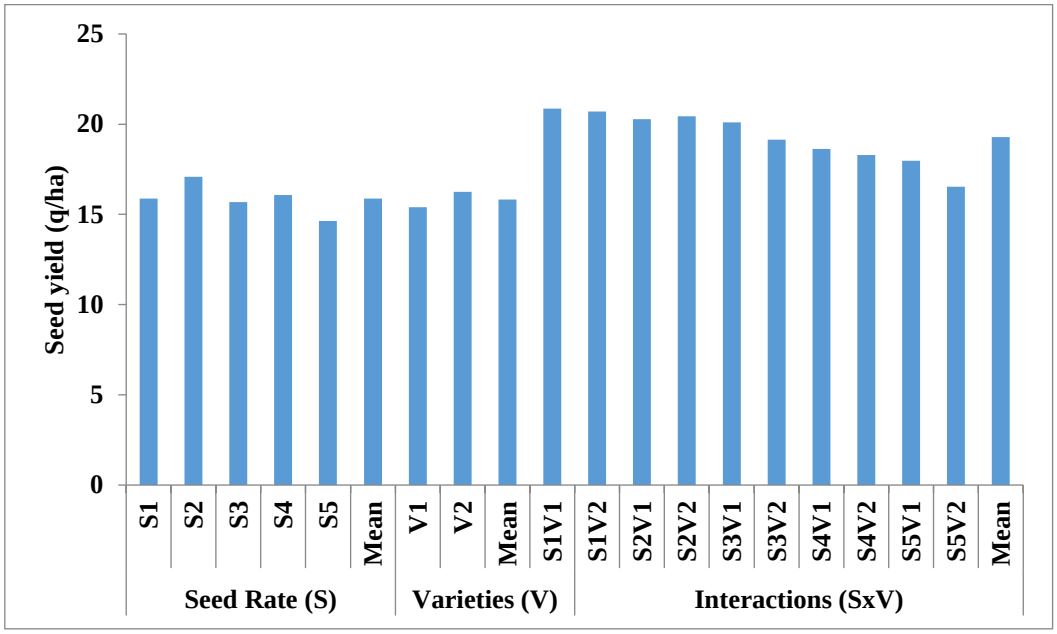



**Fig. 1.8: Effect of differential seed rates on seed yield in chickpea (large seeded)**

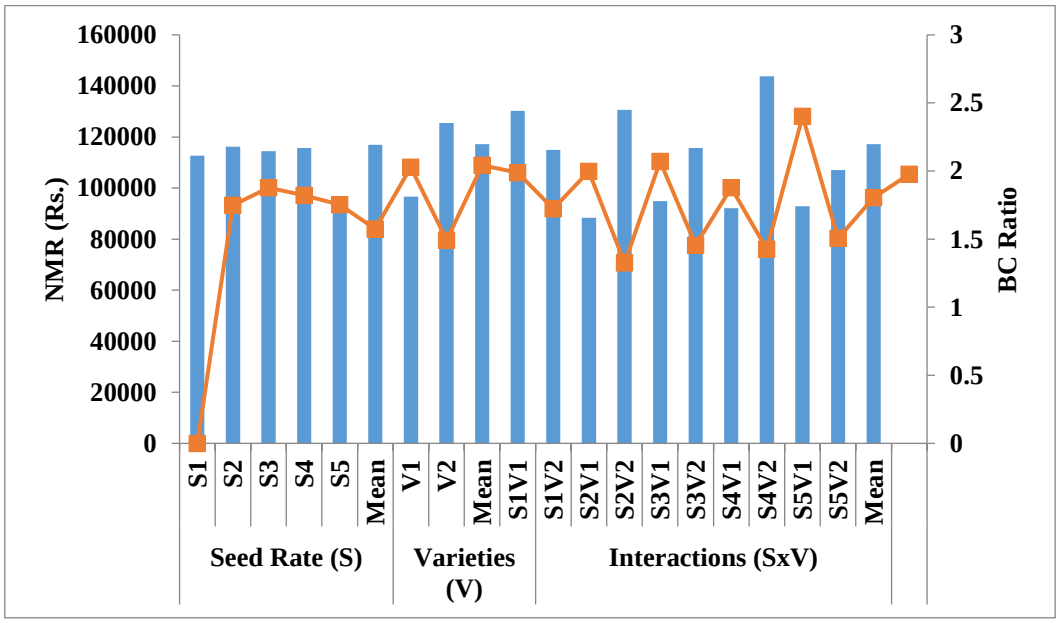



**Fig. 1.9: Effect of differential seed rates on economic indicators in chickpea (large seeded)**

Therefore, it can be concluded that **S2 (10% reduction in recommended seed rate)** was ideal for achieving maximum seed yield and economic returns in medium and large seeded varieties of chickpea. However, reduction in recommended seed rates is not economical in small seeded chickpea varieties.



**Fig. 1.10: General crop view of experimental plot at MPKV, Rahuri**

**Groundnut**

| **Treatment Details** | | |
|---|---|---|
| **Treatments** | **Factor 1. Seed rate**($S_1$to $S_5$): Five different seed rates in each category as mentioned below<br>**Factor 2. Varieties**: Two varieties of respective group as mentioned above<br>Total no. of treatments: 10 | |
| **Replications** | 3 | |
| **Design** | Factorial Randomized Block Design | |
| **Small seeded (100 seed weight: <35g)** | **Large seeded (100 seed weight: 51-65)** | **Extra Large seeded (100 seed weight: >65g)** |
| **$S_1$: 100kg/ha** (Recommended Seed Rate/ RSR)- Control | **$S_1$: 130 kg/ha** (Recommended Seed Rate/ RSR)- Control | **$S_1$: 155 kg/ha** (Recommended Seed rate/ RSR)- Control |
| **$S_2$: 90kg/ha** (10% less than RSR) | **$S_2$: 117 kg/ha** (10% less than RSR) | **$S_2$: 139.5kg/ha** (10% less than RSR) |
| **$S_3$: 80 kg/ha** (20% less than RSR) | **$S_3$: 104 kg/ha** (20% less than RSR) | **$S_3$: 124 kg/ha** (20% less than RSR) |
| **$S_4$: 70 kg/ha** (30% less than RSR) | **$S_4$: 91 kg/ha** (30% less than RSR) | **$S_4$: 108.5 kg/ha** (30% less than RSR) |
| **$S_5$: 60 kg/ha** (40% less than RSR) | **$S_5$: 78 kg/ha** (40% less than RSR) | **$S_5$: 93 kg/ha** (40% less than RSR) |

**Unified Observation:** The experiment was conducted during kharif 2024 at ten locations viz., TNAU, Coimbatore; PJTSAU, Hyderabad and MPKV, Rahuri **(Small Seeded)**; RARI, Durgapura; CSAUAT, Kanpur; and PAU, Ludhiana **(Large Seeded)**; OUAT, Bhubaneshwar; UAS, Dharwad; VNMKV, Parbhani and ANGRAU, Guntur **(Extra Large Seeded)**; to evaluate groundnut

varieties for their optimum seed rate for maximizing seed yield and recovery of pure live seeds. The list of varieties used by different centres is presented below:

| Seed Size | Centre | Varieties |
|---|---|---|
| **Small Seeded** | TNAU Coimbatore | GJG 32 (ICGV 03043) and Phule Bharti (JL 776) |
| | PJTSAU, Hyd. | |
| | MPKV, Rahuri | |
| **Large Seeded** | RARI, Durgapura | Raj Mungfali 4 (RG 638) and Gujarat Groundnut 36 |
| | CSAUAT, Kanpur | |
| | PAU, Ludhiana | |
| **Extra large-seeded** | OUAT, Bhubaneshwar | Gujarat Groundnut HPS 2, Raj Mungfali 3 |
| | UAS, Dharwad | |
| | VNMKV, Parbhani | |
| | ANGRAU, Guntur | |

**The detailed mean data over locations is presented below:**

In case of **small seeded varieties**, S1 (Recommended Seed rate-control) was found to better in terms of plant stand establishment/$m^2$ (30.48), days to 50% flowering (42.27). However, plant height at harvest (40.71), no. of pods/plant (54.45), including seed quality attributes viz. pure live seed (91.60%) were observed to be superior in case of S2. Meanwhile, S1 and S2 were found to be at par with respect to seed yield q/ha (27.21 and 27.16) as well as economic attributes i.e., net monetary returns (233918 and 231817) and BC ratio (2.92 and 2.90). Hence, S2 (10% less than the recommended seed rate) was found was par with the recommended seed rates in case of small seeded varieties of groundnut (Fig. 1.11 and 1.12).

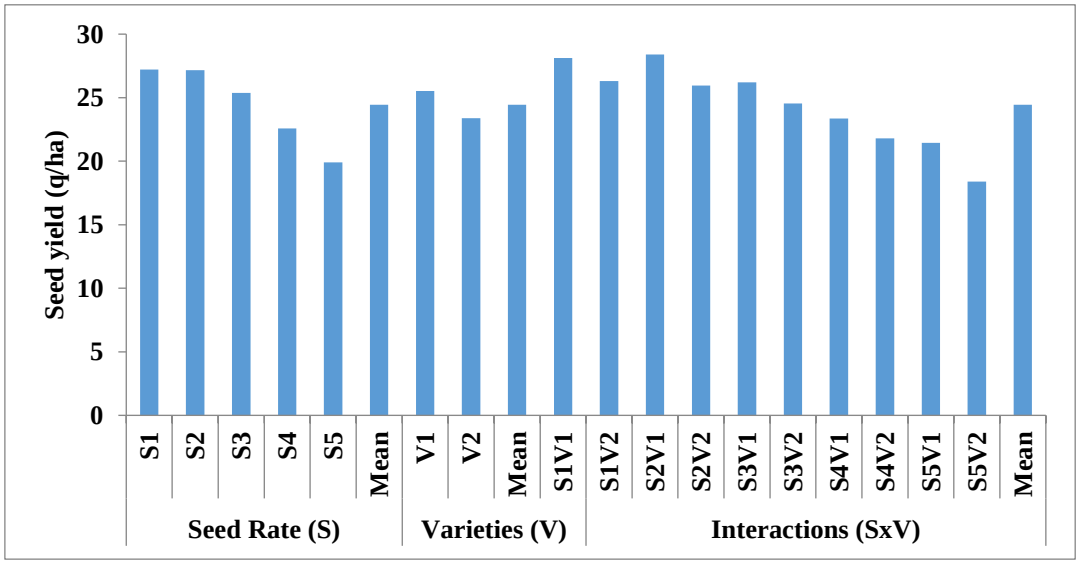



**Fig. 1.11: Effect of differential seed rates on seed yield in groundnut (small seeded)**

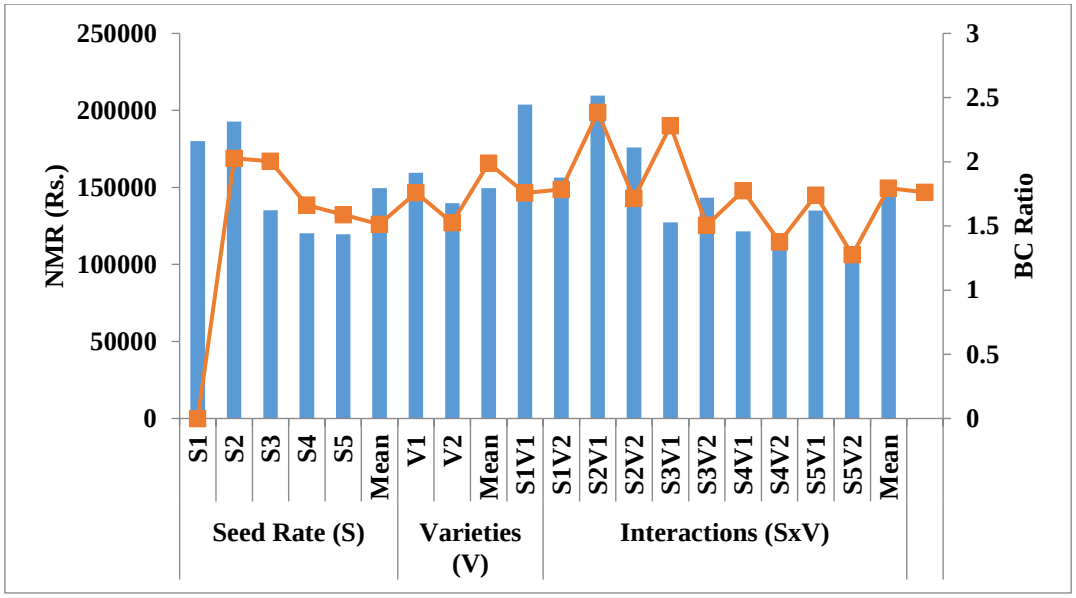



**Fig. 1.12: Effect of differential seed rates on economic indicators in groundnut (small seeded)**

In case of large seeded varieties, S1 recommended seed rate exhibited better performance in terms of plant stand establishment/$m^2$ (39.17), plant height at 30 DAS (17.24 cm) and harvest (36.55 cm), no. of pods/plant (16.69), pure live seed (85.21). However, S1 and S2 (10% less than recommended seed rate) were found to be at par with respect to seed yield/plant (g) (21.31 and 21.82), seed yield (kg/plot) (2.82 and 2.74) and seed yield q/ha (20.91 and 20.25), including seed quality and economic attributes viz., vigor index I (1069 and 1089), net monetary returns (139450 and 146642) and BC ratio (2.03 and 2.06). Hence, S2 (10% less than the recommended seed rate) was found to be at par with the recommended seed rates in case of large seeded varieties of groundnut (Fig. 1.13 and 1.14).

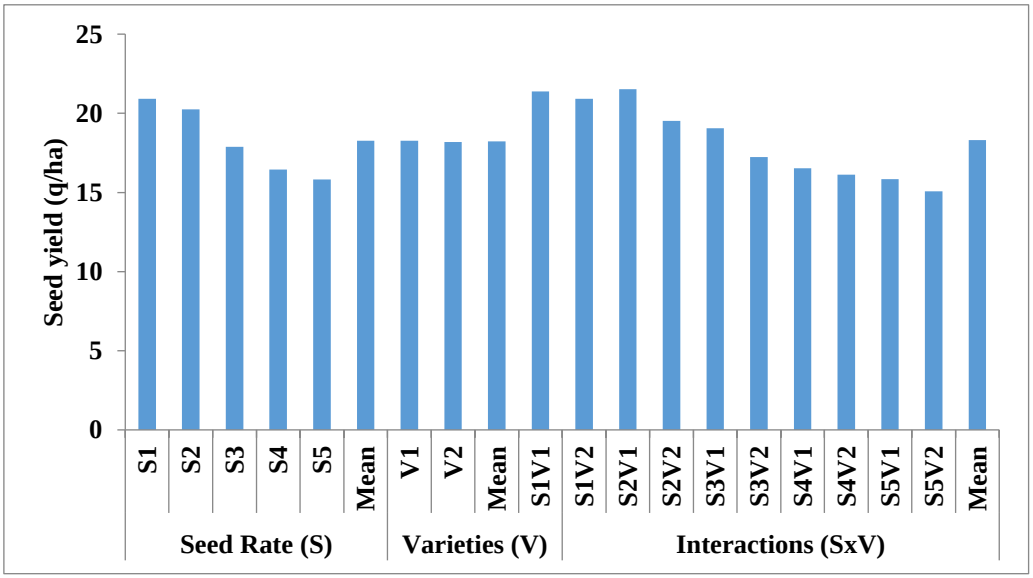



**Fig. 1.13: Effect of differential seed rates on seed yield in groundnut (large seeded)**

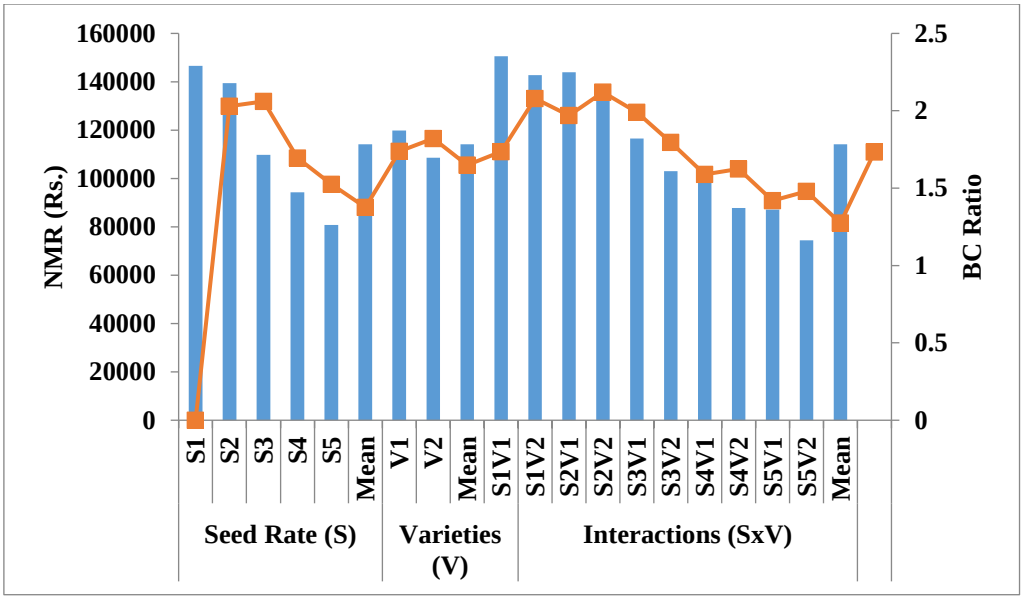



**Fig. 1.14: Effect of differential seed rates on economic indicators in groundnut (large seeded)**

In case of extra-large seeded varieties, maximum plant stand establishment/$m^2$ (53.72), days to pod formation (79.45), plant height at harvest (38.06 cm) was recorded in S1(recommended seed rate). However, S2 showed better performance with respect to plant height at 30 DAS (16.58 cm), including seed yield (2.62 kg/plot and 26.51q/ha) and economic attributes viz., net monetary returns (192739) and BC ratio (2.14). Hence, S2 (10% less than the recommended seed rate) was found to be optimum as compared to the recommended seed rates in case of extra-large seeded varieties of groundnut.

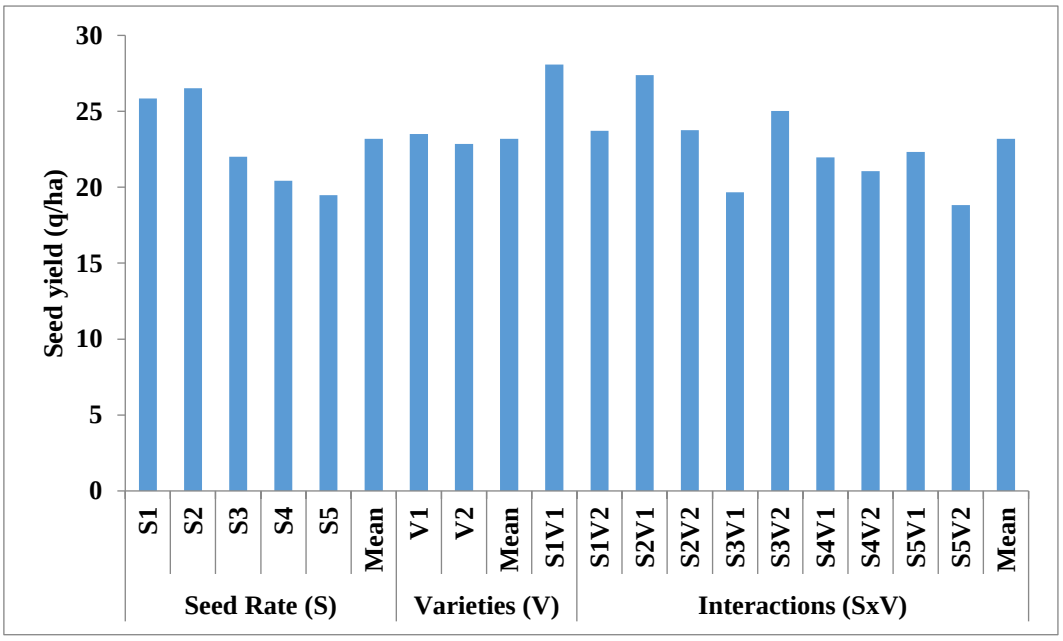



**Fig. 1.15: Effect of differential seed rates on seed yield in groundnut (extra-large seeded)**

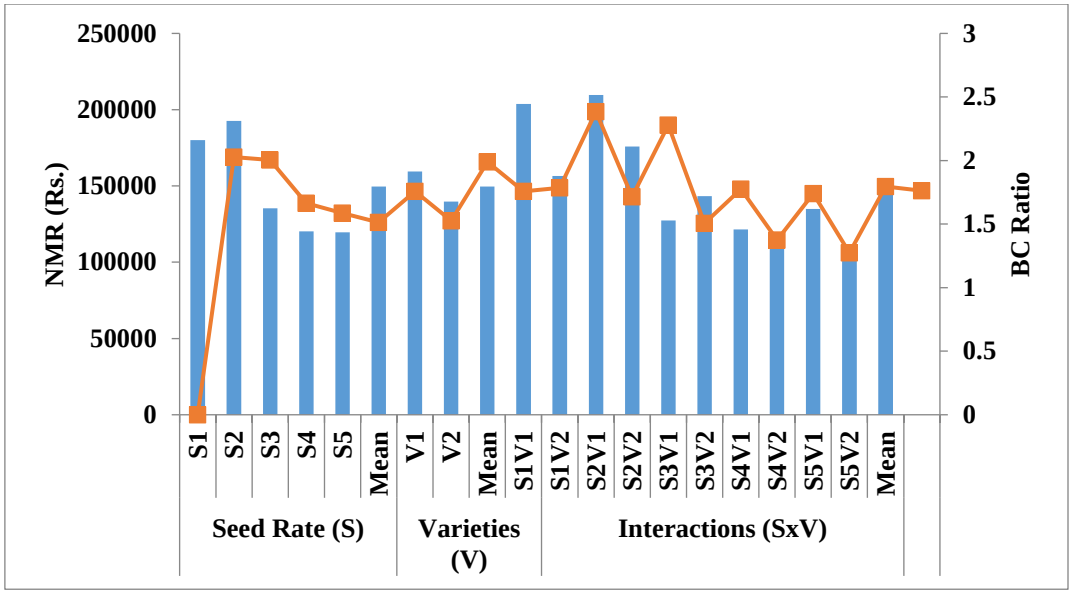



**Fig. 1.16: Effect of differential seed rates on economic indicators in groundnut (extra-large seeded)**

Therefore, it can be concluded that S2 (10% less than the recommended seed rate) was found to be at par or even superior than S1 (Recommended Seed rate-control) in case of groundnut, irrespective of the seed size.

**Experiment 3: PGPR mediated seed coating for quality seed production**

**Objective:** To study the effect of seed coating with PGPR formulations on seed yield and quality

**Expected outcome**: The study will be helpful in determining the efficacy of microbial coatings in enhancing seed yield and quality and the best identified treatments will be validated in field trials.

**Crops:** Maize, Soybean and Chickpea

**Maize**

| **Treatment Details** | |
|---|---|
| **No. of treatments: 02** | **No. of replications: 02** |
| **Seed Treatments:** | |
| **T1:** Recommended practice (Thiram @ 3 g/kg seed + Gaucho @ 10 ml/kg seed and 100% RDF) - **Control**<br>**T2:** Best Treatment (Seed treatment with Anabaena sp. + *Providencia* sp. in combination with Thiram @ 3 g/kg seed + Gaucho @ 10 ml/kg seed (75% N + Full dose of P, K) | |

**Unified Observations:** The field experiment was conducted at four centres namely; ICAR-IARI, New Delhi; TNAU, Coimbatore; PJTSAU, Hyderabad; and RPCAU, Bihar on maize variety, **HQPM - 5 Improved** during *kharif 2025* to study the effect of seed coating with PGPR

formulations on seed yield and quality attributes. The study aimed to validate the efficacy of best identified treatment under different agro-climatic zones.
The detailed mean data over locations is presented below:

**A. Effect of PGPR seed coating on plant growth and seed yield attributes in Maize:** The PGPR treated seeds exhibited significant effect on the plant growth and seed yield attributes. T2 (Seed treatment with *Anabaena* sp. + *Providencia* sp. in combination with Thiram @ 3 g/kg seed + Gaucho @ 10 ml/kg seed (75% N + Full dose of P, K) was found superior in terms of plant stand establishment/$m^2$ (10.0), plant height at 30 DAS (42.5 cm) and harvest (183 cm), leaf chlorophyll content (SPAD value - 45.7), no. of cobs/plant (1.33), seed yield (154.8 g/plant, 170.1 kg/plot and 68.1 q/ha). The same treatment also recorded lesser days to first and 50% flowering (47.6 & 54.2) (Fig. 1.17).

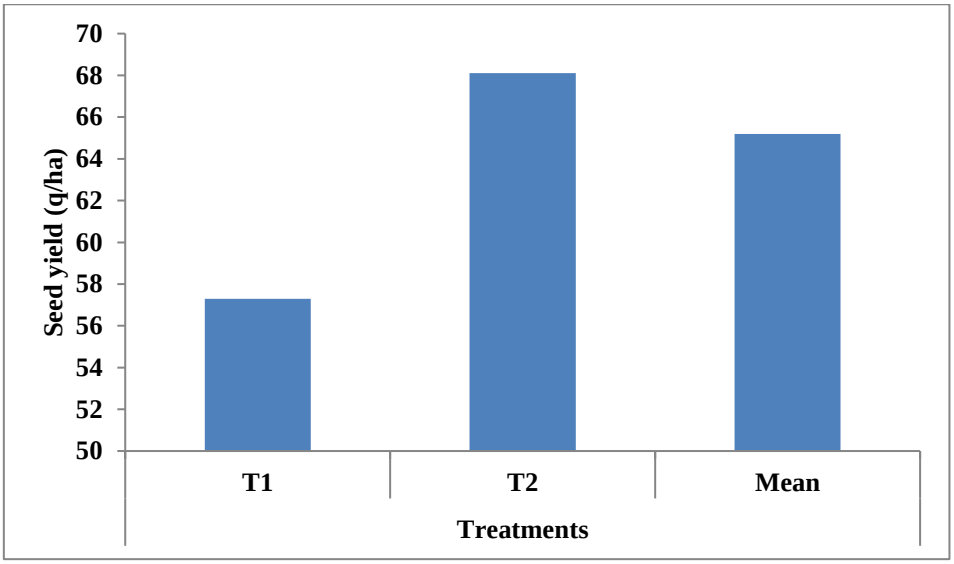



**Fig. 1.17: Effect of PGPR seed coating on seed yield in Maize**

**B. Effect of PGPR seed coating on seed recovery, seed quality and economic indicators in Maize:** T2 (Seed treatment with *Anabaena* sp. + *Providencia* sp. in combination with Thiram @ 3 g/kg seed + Gaucho @ 10 ml/kg seed (75% N + Full dose of P, K) had a significant effect on1000 seed test weight (284 g), seed quality attributes viz., germination (95%) and seedling vigor index I and II (2759 and 73). The same treatment also recorded higher net monetary returns (114464) and Benefit Cost ratio (2.2), thus enhancing the profitability to the farmers.

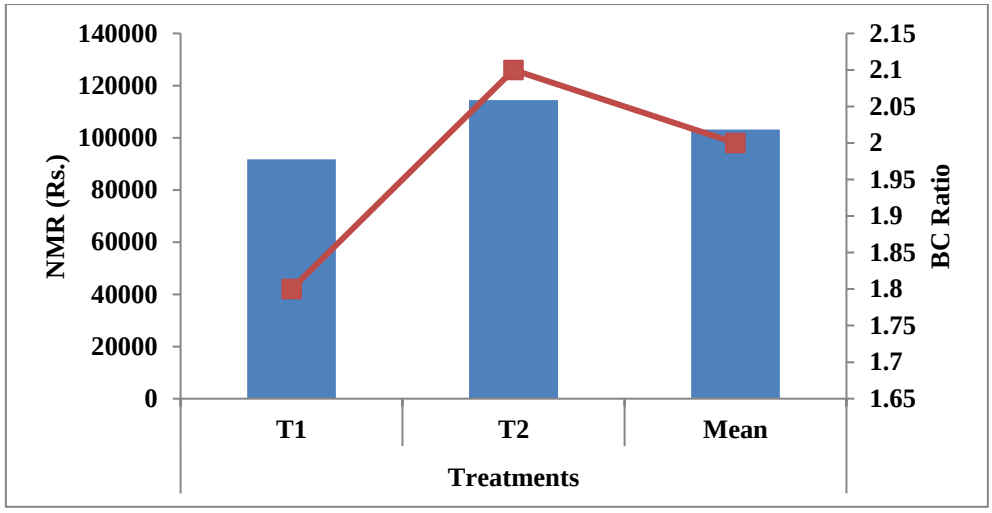



**Fig. 1.18: Effect of PGPR seed coating on economic indicators in Maize**

**Significant Observation:**

Mean data over locations revealed that the seed coating with PGPR; T2 (Seed treatment with *Anabaena* sp. + *Providencia* sp. in combination with Thiram @ 3 g/kg seed + Gaucho @ 10 ml/kg seed (75% N + Full dose of P, K) resulted in significant increase in plant growth, crop performance, seed yield and quality, including economic indicators with respect to net monetary returns (Rs 114464) and BC ratio (2.2) in case of T2.

**Conclusion: Seed coating with *Anabaena* sp. + *Providencia* sp. in combination with Thiram @ 3 g/kg seed + Gaucho @ 10 ml/kg seed (75% N + Full dose of P, K),** (T2) was effective in improving the plant growth, seed yield and seed quality parameters as well as reducing the cost of inputs viz., fertilizers in maize, which ensured higher profitability to the farmers in terms of net monetary returns and BC ratio.

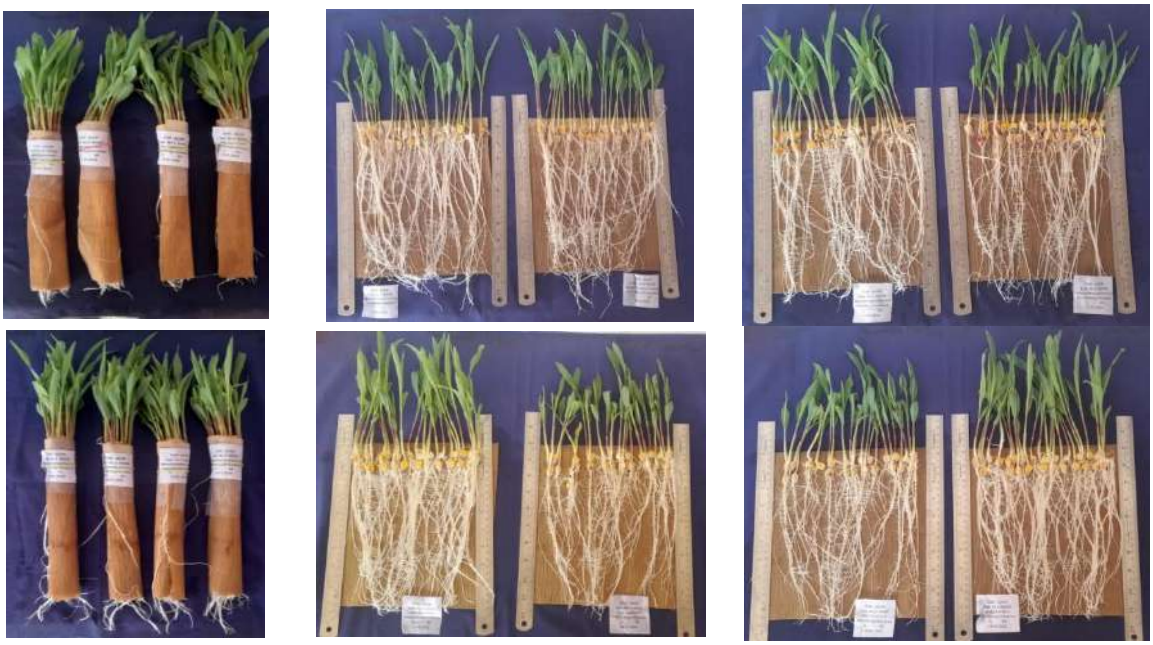


**Fig. 1.19: Seed quality evaluation of maize treatments at TNAU, Coimbatore**

**Soybean**

| **Treatment Details** | |
|---|---|
| **No. of treatments: 02** | **No. of replications: 02** |
| **Seed Treatments:** | |
| **T1:** Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with *Rhizobium* and RDF) - Control<br>**T2: Best Treatment** (*Anabaena Rh* in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K) | |

**Unified Observations:** The field experiment was conducted at four centres namely; four centres namely, MPKV, Rahuri; UAS, Bengaluru: JNKVV, Jabalpur and VNMKV, Parbhani on soybean variety, JS 20-98 during *kharif* 2025 to study the effect of seed coating with PGPR formulations on seed yield and quality attributes. The study aimed to validate the efficacy of best identified treatment under different agro-climatic zones. The detailed mean data over locations is presented below:

**A. Effect of PGPR seed coating on plant growth and seed yield attributes in soybean:** The PGPR treated seeds exhibited significant effect on the plant growth and seed yield attributes (Fig. 1.20). T2 (*Anabaena Rh* in combination with Thiram + Bavistin (2:1) @ 3 g/kg (75% N + Full dose of P, K)) was found to be superior with respect to field emergence (83.82 %), plant stand establishment/$m^2$ (29.94), plant height at 30 DAS and harvest (27.09 cm and 50.11 cm), number of nodules/ effective nodules per plant (26.03), leaf chlorophyll content (SPAD value - 46.06), days to 50% flowering (45), no. of pods/plant (46.4) and seed yield (21.19 g/ plant, 49.47 kg/plot and 20.03 q/ha).

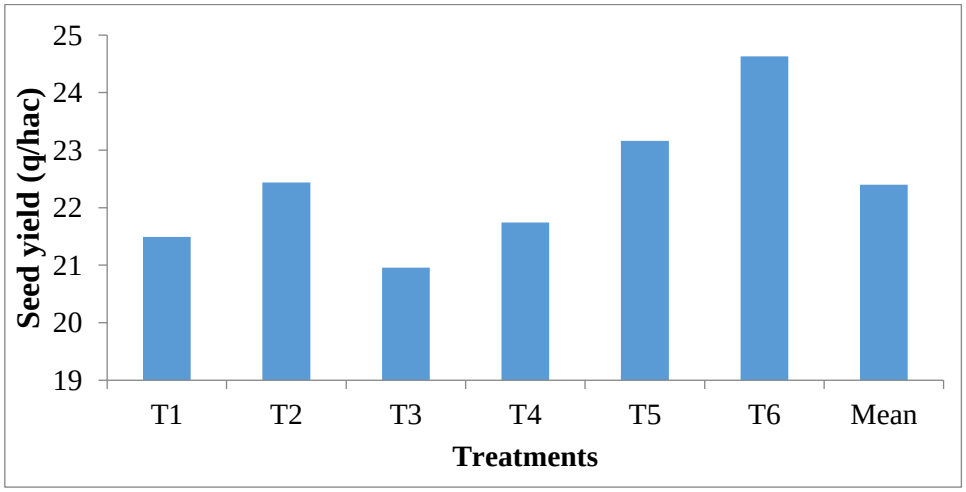



**Fig. 1.20: Effect of PGPR seed coating on seed yield in soybean**

**B. Effect of PGPR seed coating on seed recovery, seed quality and economic indicators in soybean:** The mean over locations revealed that seed coating with PGPR had a significant

effect on seed quality and economic attributes in soybean. T2 (*Anabaena Rh* in combination with Thiram + Bavistin (2:1) @ 3 g/kg (75% N + Full dose of P, K)) was found to be superior with respect to seed quality parameters viz. Germination (94.53%), 1000 seed test weight (101.4 g), seedling vigour index I and II (2272 and 82.7). The economic indicators also exhibited superiority with respect to net monetary returns (Rs. 96606) and Benefit Cost ratio (1.98) in case of T2 (Fig. 1.21).

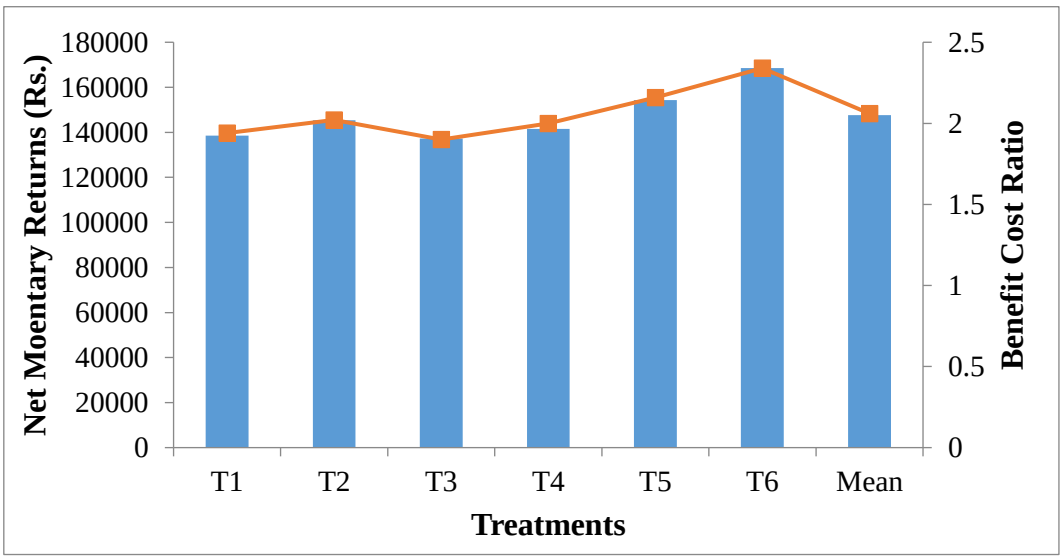



**Fig. 1.21: Effect of PGPR seed coating on economic indicators in Soybean**

**Significant Observation:**

Mean data over locations revealed that the seed coating with PGPR; T2 (Anabaena Rh in combination with Thiram + Bavistin (2:1) @ 3 g/kg (75% N + Full dose of P, K)) resulted in significant increase in plant growth, crop performance, seed yield and quality, including economic indicators with respect to net monetary returns (Rs. 96606) and Benefit Cost ratio (1.98).

**Conclusion:** Seed coating with ***Anabaena Rh*** **in combination with Thiram + Bavistin (2:1) @ 3 g/kg (75% N + Full dose of P, K)** (T2) was effective in improving the plant growth, seed yield, seed quality parameters as well as reducing the cost of inputs viz., fertilizers in soybean, resulting in higher profitability to the farmers in terms of net monetary returns and BC ratio.




**Fig. 1.22: Experimental plot view at MPKV, Rahuri**

**Chickpea**

| **Treatment Details** | |
|---|---|
| **No. of treatments: 06** | **No. of replications: 04** |
| **Seed Treatments:** | |
| **T1** | Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with *Rhizobium* and RDF) - Control |
| **T2** | Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with *Rhizobium* and75% N + Full dose of P, K*)* |
| **T3** | *Anabaena Rh* (75% N + Full dose of P, K) |
| **T4** | *Anabaena R*h in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K) |
| **T5** | BF1-4 *Cyanobacterium consortium* (75% N + Full dose of P, K) |
| **T6** | BF1-4 *Cyanobacterium consortium* in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K) |

**Unified Observation:** The field experiment was conducted in chickpea varieties, **Pusa 3062 (Desi)** and **Pusa 3022 (Kabuli)** during rabi 2024-25 at four centres namely, ICAR-IARI, New Delhi; MPKV, Rahuri; PDKV, Akola, RARI, Durgapura to study the effect of seed coating with PGPR formulations on seed yield and quality attributes. The detailed mean data over locations is presented below:

**A. Effect of PGPR seed coating on plant growth and seed yield attributes in Chickpea (Desi) (Mean over locations):** The PGPR seed treatments exhibited significant effect on the plant growth and seed yield attributes (Fig. 1.23). Among the different treatments, T6 (BF1-4 Cyanobacterium consortium in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K) was found to be superior with respect to plant stand establishment/$m^2$ (31.36),

plant height at 30 DAS and harvest (24.8 cm and 61cm), no. of nodules/ effective nodules plant (30.9), leaf chlorophyll content (SPAD value - 44.2), no. of pods/plant (104) and seed yield (20.54 g/ plant, 2.24 kg/plot and 24.49 q/hac).

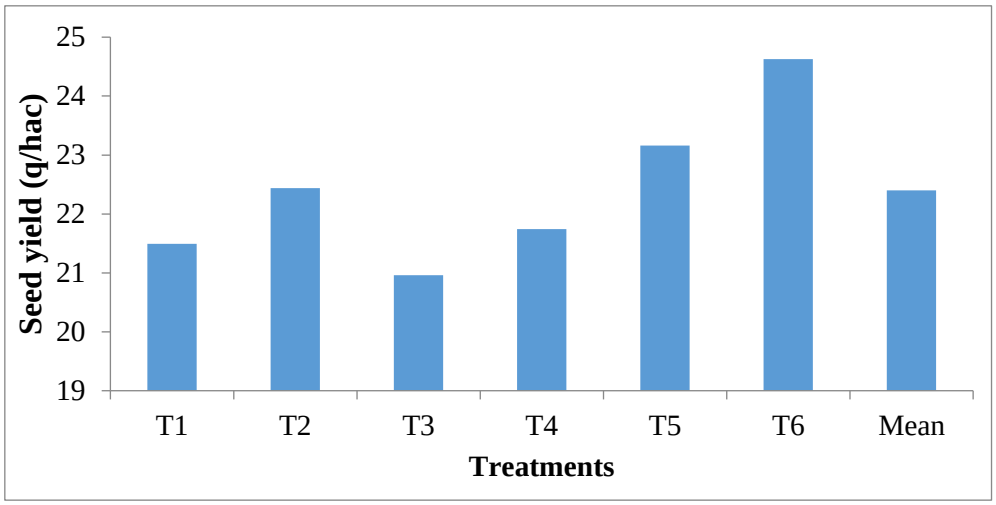



**Fig. 1.23: Effect of PGPR seed coating on seed yield in Chickpea (desi)**

**B. Effect of PGPR seed coating on seed recovery, seed quality and economic indicators in Chickpea (Desi) (Mean over locations):** The mean over locations revealed that seed coating treatments had a significant effect on test weight, seed quality attributes (seed germination, vigour index), net monetary returns and BC ratio in chickpea (Fig. 1.24). Among the various treatments, T6 (BF1-4 *Cyanobacterium consortium* in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K) was found to be promising with respect to seed quality parameters viz. 1000 seed test weight (212 g), seed germination (93.25%) and seedling vigour index II (120.74), including economic indicators viz. net monetary returns (Rs.127606) and Benefit Cost ratio (1.92).

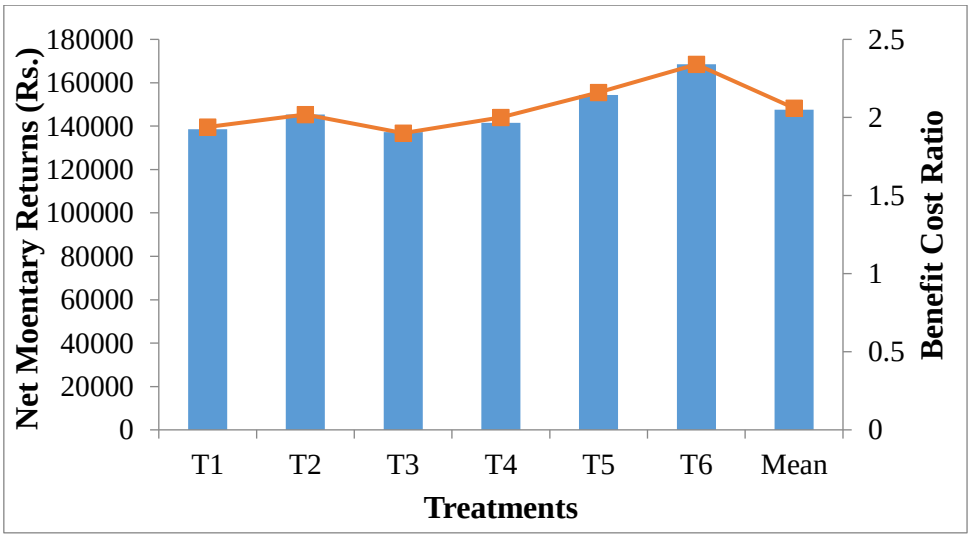



**Fig. 1.24: Effect of PGPR seed coating on economic indicators in chickpea (desi)**

**Significant Observation:**

Mean data over locations revealed that the seed coating treatment; T6 (BF1-4 Cyanobacterium consortium in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K) resulted in significant increase in plant height at 30 DAS and harvest (24.77 cm and 61.02cm), seed yield (20.54 g/ plant, 2.24 kg/plot and 24.49 q/hac)), test weight (212.05g), Germination (93.25%) as well as monetary returns (Rs. 127606) and Benefit Cost ratio (1.92).

**Conclusion:** Seed coating with PGPR formulation i.e. **BF1-4 *Cyanobacterium consortium* in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K** was effective in enhancing the plant growth, seed yield, no. of nodules/plant, leaf chlorophyll content, seed quality parameters as well as reducing the cost of inputs viz., fertilizers in chickpea, and hence, maximizing farmers' profitability through higher net monetary returns and BC ratio.

**A. Effect of PGPR seed coating on plant growth and seed yield attributes in Chickpea (Kabuli) (Mean over locations):** The PGPR seed treatments exhibited significant effect on the plant growth and seed yield attributes (Fig. 1.25). Among the different treatments, T6 (BF1-4 *Cyanobacterium consortium* in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K) was found to be superior with respect to field emergence (84.33%), plant height at 30 DAS (31.24 cm), no. of nodules/ effective nodules per plant (23.55), no. of pods/plant (137.75) and seed yield (38.86 g/ plant, 2.26 kg/plot and 24.63 q/hac).

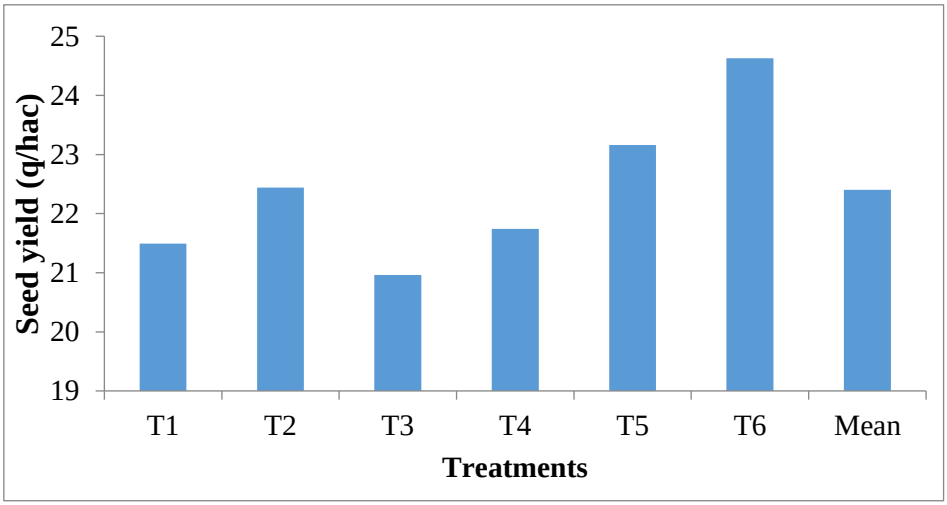



**Fig. 1.25: Effect of PGPR seed coating on seed yield in Chickpea (kabuli)**

**B. Effect of PGPR seed coating on seed recovery, seed quality and economic indicators in Chickpea (Kabuli) (Mean over locations):** The mean over locations revealed that seed coating treatments had a significant effect on test weight, seed quality attributes (seed germination, vigour index), net monetary returns and BC ratio in chickpea (Fig. 1.26). Among the various treatments, T6 (BF1-4 *Cyanobacterium consortium* in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K) was found to be promising with respect to seed quality parameters viz. 1000 seed test weight (281.5 g), seed germination (91.31%) and seedling

vigour index II (133), including economic indicators viz. net monetary returns (Rs. 168593) and Benefit Cost ratio (2.34).

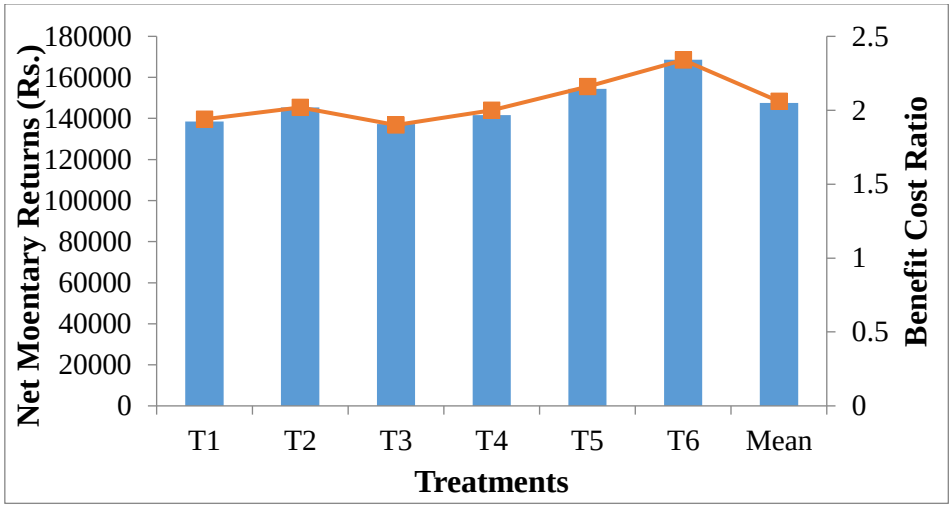



**Fig. 1.26: Effect of PGPR seed coating on economic indicators in chickpea (kabuli)**

**Significant Observation:**

Mean data over locations revealed that the seed coating treatment; T6 (BF1-4 Cyanobacterium consortium in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K) resulted in significant increase in plant height at 30 DAS (31.24cm), seed yield (38.86g/ plant, 2.26kg/plot and 24.63 q/hac), test weight (281.47g), seed germination (91.31%) as well as net monetary returns (Rs. 1685932/-) and Benefit Cost ratio (2.34).

**Conclusion:** Seed coating with PGPR formulations i.e. **BF1-4 *Cyanobacterium consortium* in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K** was effective in enhancing the plant growth, seed yield, no. of nodules, leaf chlorophyll content, seed quality parameters as well as reducing the cost of inputs viz., fertilizers in both varieties of chickpea, and hence, maximizing farmers' profitability through higher net monetary returns and BC ratio.




**Fig. 1.27: Field view of experiment on PGPR mediated seed coating for quality seed production conducted during 2022-2025 at Dr. PDKV, Akola**

**Experiment 4: Evaluation of liquid bio-fertilizers in enhancing seed yield and quality**

**Rationale:** Liquid bio-fertilizers consist of living microorganisms that enhance soil properties and promote plant growth and yield. Liquid biofertilizers have been used in different crops and outyield chemical or carrier-based fertilizers in terms of plant growth. However, more research is required to overcome the limitations for better climate adaptation, longer shelf life and development of better liquid inoculants etc.

**Objective:** To evaluate the effectiveness of liquid biofertilizers on seed yield and quality

**Crops:** Soybean, Wheat and Chickpea
**Expected outcome:** Identification of the suitable liquid biofertilizer on the basis of crop, season and soil type across the country and promotion of organic seed production

**Soybean**

| **Treatment Details** | |
|---|---|
| **No. of treatments:** 08 | **Replications:** 03 |
| **Design** | RBD (Randomized Block Design) |
| **Sowing:** Direct sowing @70kg seed/ha; depth of sowing: 4-5cm | |

| Treatments | Treatment details |
|---|---|
| **T1** | Control (No spray) |
| **T2** | SRDF+ Recommended seed treatment practice (Thiram + Bavistin (2:1) @3g/kg in combination with Rhizobium@ 5g/ kg seed |
| **T3** | Jawahar EM culture@ 20ml/kg seed |
| **T4** | Jawahar PSB @ 20 ml/kg seed |
| **T5** | Jawahar KSB @ 20 ml/kg seed |
| **T6** | Jawahar *Azospirillum*@ 20 ml/kg seed |
| **T7** | Jawahar *Pseudomonas* @ 20 ml/kg seed |
| **T8** | Jawahar Rhizobium culture@ 20 ml/kg seed |

**List of soybean varieties used by the centres**

| Crops | Centre | Cultivar |
|---|---|---|
| Soybean (7) | VNMKV, Parbhani | JS 20-116 |
| | JNKVV, Jabalpur | JS 20-98 |
| | ICAR-IISS, RS, Bengaluru | JS-335 |
| | GBPUAT, Pantnagar | PS 1225 |
| | MPKV, Rahuri | Phule Durva |
| | PAU, Ludhiana | NRCSL1 |
| | UAS, Bangalore | JS-20-116 |

**Unified Observation**: The experiment was conducted at seven locations viz., VNMKV, Parbhani; JNKVV, Jabalpur; ICAR-IISS, RS, Bengaluru; GBPUAT, Pantnagar; MPKV, Rahuri; PAU, Ludhiana and UAS, Bangalore to evaluate the effectiveness of liquid biofertilizers on seed yield and quality

The detailed mean data over locations is presented below:

**A. Effect of seed treatment with liquid bio-fertilizer on plant growth and seed yield attributes in soybean:** Among the different seed treatments, T3 (SRDF+ seed treatment with Jawahar EM culture@ 20ml/kg) was found to be superior with respect to leaf chlorophyll content (SPAD value - 46.68), plant height at harvest (58.09 cm), no. of pods/plant (64.22), seed yield (26.26 g/plant, 2.8 kg/plot and 20.45 q/ha). However, field emergence, plant stand establishment/ $m^2$ and no. of nodules/effective nodules per plant was recorded lower values in T3 (Fig. 1.28).

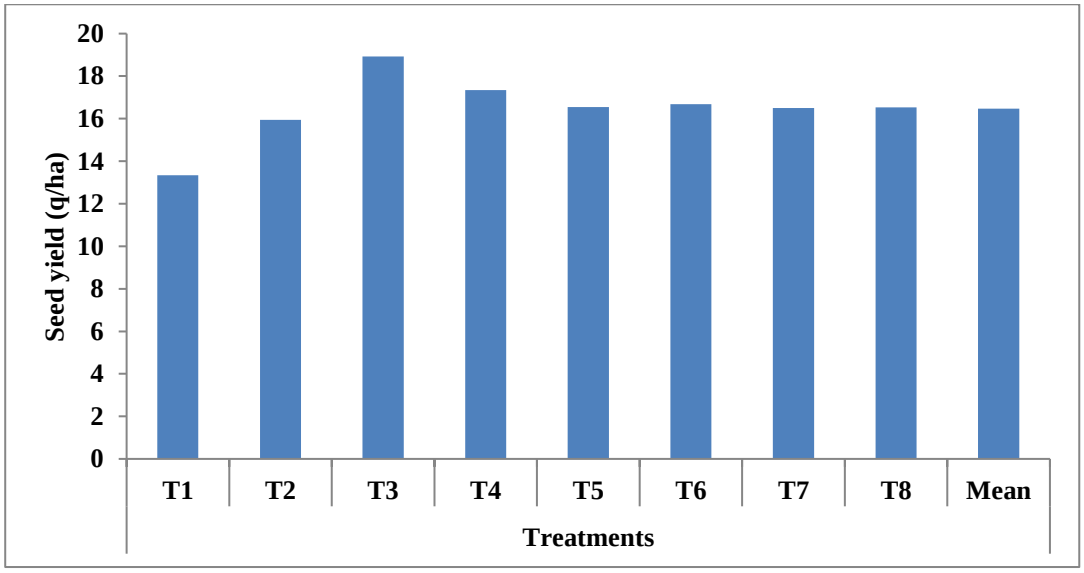



**Fig. 1.28: Effect of seed treatment with liquid bio-fertilizer on seed yield in soybean**

**B. Effect of seed treatment with liquid bio-fertilizers on seed quality and economic indicatorsin soybean:** T3 had a significant effect on seed quality and economic indicators, viz. 1000 seed weight (94.53g), seed germination (92.64%), seedling vigor index - I and II (2533.05 and 74.98), including net monetary returns (Rs. 134056) and Benefit Cost ratio (2.67) as compared to the other treatments. (Fig. 1.29).

**Significant Observation:**

Mean data over locations revealed that the seed coating treatment; T3 (SRDF+seed treatment with Jawahar EM culture@ 20ml/kg) resulted in significant increase in plant growth, seed yield and seed quality parameters, thus ensuring higher net monetary returns and Benefit Cost ratio.

**Conclusion:** Seed treatment with **Jawahar EM culture@ 20ml/kg** exhibited considerably higher plant growth, seed yield and seed quality as compared to other treatments. The same treatment recorded the highest net monetary returns and BC ratio.

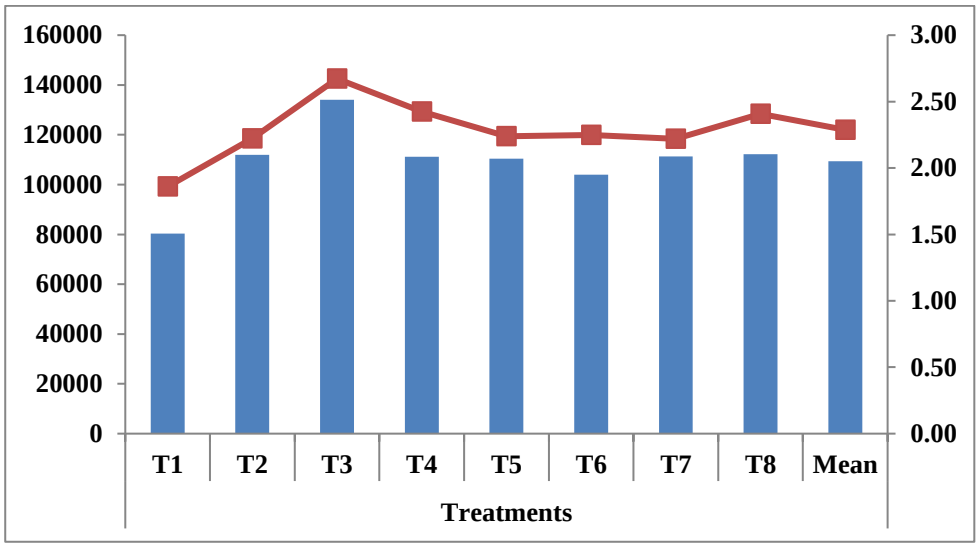



**Fig. 1.29: Effect of seed treatment with liquid bio-fertilizer on economic indicators in soybean**

**Chickpea**

| **Treatment Details** | |
|---|---|
| **No. of treatments:** 09 | **Replications:** 04 |
| **Design** | RBD (Randomized Block Design) |
| **Sowing:** Direct sowing @60-80kg seed/ha, depth of sowing: 6-8cm | |

| **Treatments** | **Treatment details (Chickpea)** |
|---|---|
| **T1** | No seed treatment – Control |
| **T2** | SRDF+ Recommended seed treatment practice (Thiram + Bavistin (2:1) @3g/kg in combination with Rhizobium@ 5g/ kg seed |
| **T3** | SRDF+seed treatment with Jawahar EM culture@ 20ml/kg seed |
| **T4** | SRDF+ seed treatment with Jawahar PSB @ 20 ml/kg seed |
| **T5** | SRDF+ seed treatment with Jawahar KSB @ 20 ml/kg seed |
| **T6** | SRDF+ seed treatment with Jawahar *Azospirillum*@ 20 ml/kg seed |
| **T7** | SRDF+seed treatment with Jawahar *Pseudomonas* @ 20 ml/kg seed |
| **T8** | SRDF+seed treatment with Jawahar Rhizobium culture@ 20 ml/kg seed |
| **T9** | SRDF + seed treatment with Jawahar Trichoderma culture@ 20 ml/kg seed |

**List of chickpea varieties used by the centres**

| **Crops** | **Centre** | **Cultivar** |
|---|---|---|
| Chickpea (4) | CSAUAT, Kanpur | KGD 1168 |

| | | |
|---|---|---|
| | GBPUAT, Pantnagar | Pant Gram 5 |
| | PAU, Ludhiana | PBG 10 |
| | MPKV, Rahuri | Phule Vikrant |

**Unified Observation**: The experiment was conducted at four locations viz., CSAUAT, Kanpur; GBPUAT, Pantnagar, PAU, Ludhiana, MPKV, Rahuri to evaluate the effectiveness of liquid biofertilizers on seed yield and quality. The detailed mean data over locations is presented below:

**A. Effect of seed treatment with liquid bio-fertilizer on plant growth and seed yield attributes in chickpea:** Among the different seed treatments, T5 (SRDF+ seed treatment with Jawahar KSB @ 20 ml/kg seed) was found to be superior with respect to field emergence (89.82), plant height at 30 DAS and harvest (22.41cm&57.70 cm), no. of pods/plant (96.09) and seed yield (25.09g/ plant, 1.92kg/plot and 18.79q/hac).

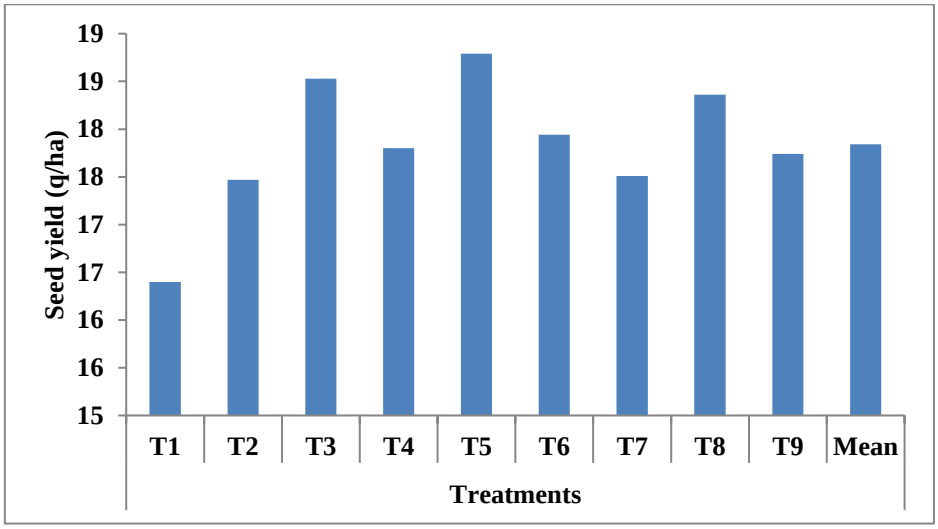



**Fig. 1.30: Effect of seed treatment with liquid bio-fertilizer on seed yield in Chickpea**

**B. Effect of seed treatment with liquid bio-fertilizers on seed quality and economic indicators in Chickpea (Mean over locations):** The mean over locations revealed that seed coating treatments had a significant effect on test weight, seed quality attributes (seed germination, vigour index), net monetary returns and BC ratio in chickpea (Fig. 1.31). Among the various seed treatments; T5 (SRDF+ seed treatment with Jawahar KSB @ 20 ml/kg seed) was found to be promising with respect to seed quality parameters viz. 1000 seed test weight (217.5), Germination (95.2%) and seedling vigour index II (55.5), including economic indicators viz. net monetary returns (Rs. 107958/-) and Benefit Cost ratio (1.81).

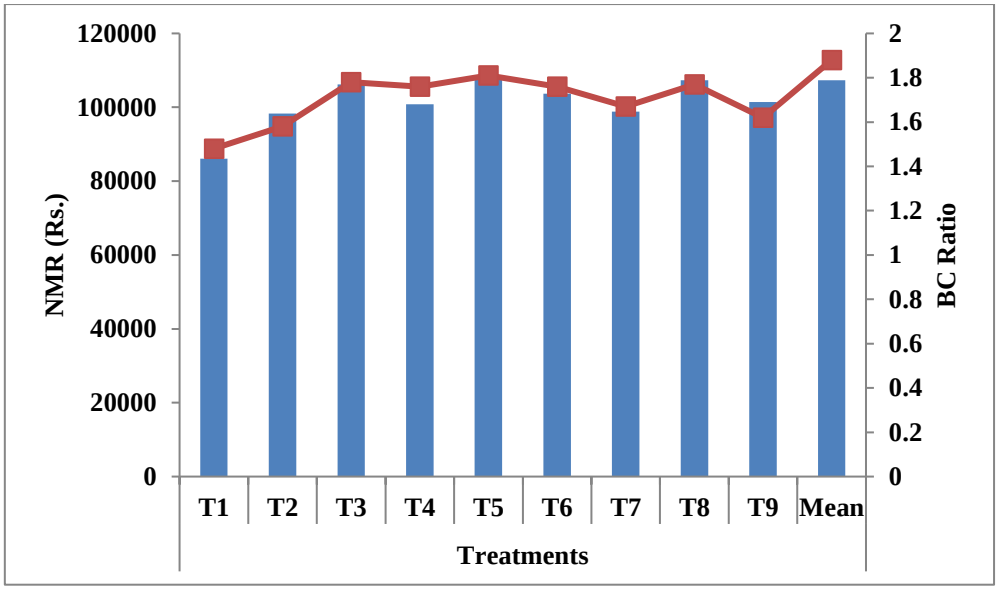



**Fig. 1.31: Effect of seed treatment with liquid bio-fertilizer on economic indicators in chickpea**

**Significant Observation:**

Mean data over locations revealed that the seed coating treatment combination, T5 (SRDF+ seed treatment with Jawahar KSB @ 20 ml/kg seed) resulted in significant increase in field emergence (89.82 %), plant height at 30 DAS and harvest (22.41cm& 57.70 cm), no. of pods/plant (96.09) and seed yield (25.09 g/ plant, 1.92 kg/plot and 18.79 q/hac) including test weight (217.54), Germination (95.19%) and seedling vigour index II (55.50), including economic indicators viz. net monetary returns (Rs. 107958/-) and Benefit Cost ratio (1.81).

**Conclusion:** It can be concluded that seed coating with PGPR formulations i.e. **SRDF + seed treatment with Jawahar KSB @ 20 ml/kg seed** (T5) was effective in enhancing the plant growth, seed yield, no. of pods/plant, seed quality parameters as well as reducing the cost of inputs viz., fertilizers in chickpea, and hence, maximizing farmers' profitability through improved net monetary returns and BC ratio.



**Fig. 1.32: Field view of at PAU, Ludhiana**

**Wheat**

| **Treatment Details** | |
|---|---|
| **No. of treatments:** 07 | **Replications:** 04 |
| **Design** | RBD (Randomized Block Design) |
| **Sowing:** Direct sowing depth of sowing: 6-8cm | |

| Treatments | Treatment details (Wheat) |
|---|---|
| **T1** | No seed treatment – Control |
| **T2** | SRDF+ Recommended seed treatment practice (Thiram + Bavistin (2:1) @3g/kg in combination with Rhizobium@ 5g/ kg seed |
| **T3** | SRDF+seed treatment with Jawahar EM culture@ 20ml/kg seed |
| **T4** | SRDF+seed treatment with Jawahar PSB @ 20 ml/kg seed |
| **T5** | SRDF+seed treatment with Jawahar KSB @ 20 ml/kg seed |
| **T6** | SRDF+seed treatment with Jawahar *Azospirillum*@ 20 ml/kg seed |
| **T7** | SRDF+seed treatment with Jawahar *Pseudomonas* @ 20 ml/kg seed |

**List of wheat varieties used by the centres**

| Crops | Centers | Cultivars selected |
|---|---|---|
| Wheat (5) | VNMKV, Parbhani | Trimbak |
| | JNKVV, Jabalpur | JW 33-36 |
| | CSAUAT, Kanpur | K 1317 |
| | NDUAT, Ayodhya | DBW222, HD2967 |
| | OUAT, Bhubaneswar | KW 101 |

**Unified Observation**: The experiment was conducted at five locations viz., VNMKV, Parbhani; JNKVV, Jabalpur; CSAUAT, Kanpur; NDUAT, Ayodhya and OUAT, Bhubaneswar to evaluate the effectiveness of liquid biofertilizers on seed yield and quality on wheat. The detailed mean data over locations is presented below:

**A. Effect of seed treatment with liquid bio-fertilizer on plant growth and seed yield attributes in wheat:** Among the different seed treatments, T7 (SRDF + seed treatment with Jawahar Pseudomonas @ 20 ml/kg seed) exhibited maximum plant stand establishment/$m^2$, plant height at 30 DAS (35.96 cm) and harvest (90.47 cm**),** seed yield (3.89 kg/plot and 46.65 q/hac). (Fig. 4.9)

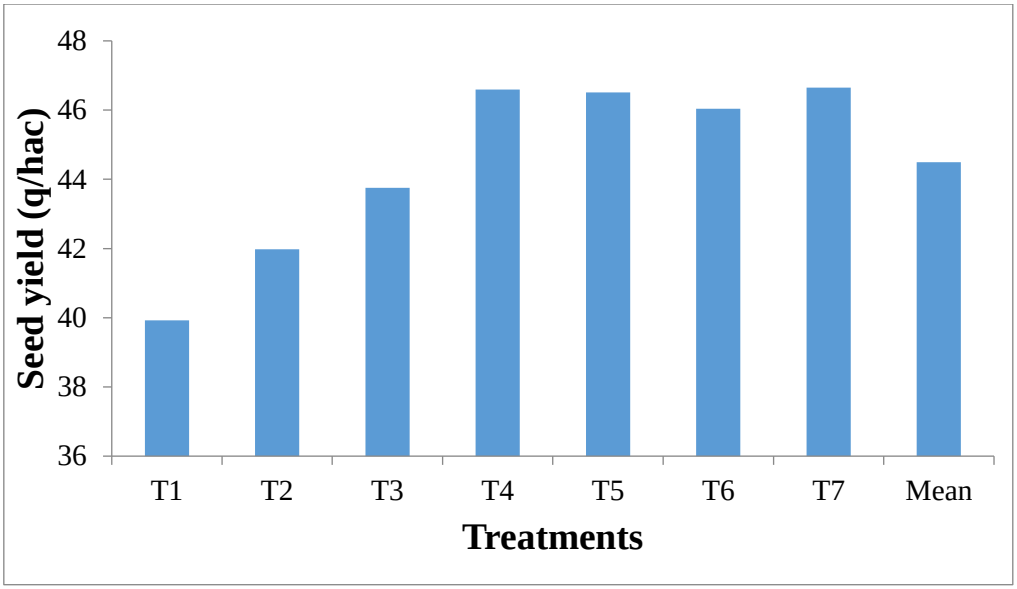



**Fig. 1.33: Effect of seed treatment with liquid bio-fertilizer on seed yield in wheat**

**B. Effect of seed treatment with liquid bio-fertilizer on seed quality and economic indicators in wheat:** With respect to seed quality and economic indicators, T7 (SRDF + seed treatment with Jawahar Pseudomonas @ 20 ml/kg seed) had a significant effect on the 1000 seed test weight (46.78), seedling vigor index I and II (2488 and 18.95), including net monetary returns (Rs. 217943) and BC ratio (2.41) (Fig. 1.34)

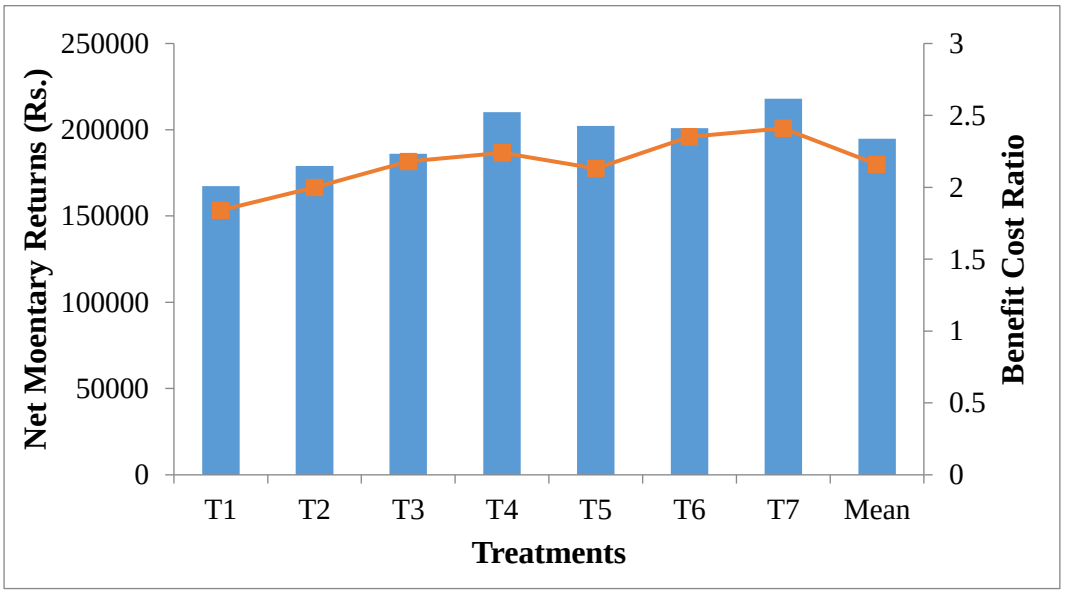



**Fig. 1.34: Effect of seed treatment with liquid bio-fertilizer on economic indicators in wheat**

**Significant Observation:** Mean data over locations revealed that SRDF + seed treatment with Jawahar Pseudomonas @ 20 ml/kg seed (T7) resulted in significant increase in plant growth, seed yield, seed quality attributes, including net monetary returns and BC ratio.

**Conclusion:** Seed treatment with **Jawahar Pseudomonas culture@ 20ml/kg seed + SRDF** was effective in improving the plant growth and seed yield as well as reducing the cost of fertilizers in soybean and hence, ensuring higher net monetary returns and BC ratio.



**Fig. 1.35: Experimental field view at VNMKV, Parbhani**

**Experiment 5: Enhancing seed yield and quality in off season soybean through application of plant growth regulators**

**Rationale:** Generally, the time of planting varies depending on the climatic conditions of the region and the variety to be grown; early or late planting reduces crop yield significantly. Besides, many seed lots may fail to meet the requisite germination standards due to the heavy rains during harvesting, resulting in severe shortage of quality seeds for planting in the next season. In such situations, contingency seed production is very much essential, especially in the off-season. Hence, there is a need to identify the suitable planting time for promoting quality seed production during the off-season.

**Plant growth regulator treatments**

- **T1**- Control
- **T2-**Salicylic Acid@400ppm
- **T3-**Salicylic Acid@800ppm
- **T4-**Thiourea@400ppm
- **T5-**Thiourea@800ppm
- **T6-**NAA@400ppm
- **T7-**NAA@800ppm

**Spray Schedule**

- **S1-**Flowering stage
- **S2-**Vegetative stage
- **S3-**Both Flowering and vegetative stage

**Unified Observation**: The experiment was conducted at eight locations during off season (2024-25) viz., PJTSAU, Hyderabad; UAS Dharwad; VNMKV, Parbhani; UAS, Bengaluru; JNKVV, Jabalpur; MPKV Rahuri and PDKV, Akola; UAS, Raichur to enhance seed yield and quality in off season soybean through application of plant growth regulators.

**The best planting window period for off-season sowing of soybean was identified in the previous Seed Production and Certification experiments which are given below:**

| Centre | Variety | Best planting window |
|---|---|---|
| PJTSAU, Hyderabad | ASB-50 | 3rd to 4th week of September |
| UAS, Dharwad | DH-256 | 1st to 4th week of November |
| VNMKV, Parbhani | MAUS-725 | 1st to 4thweek of November |
| UAS, Bengaluru | JS-335 | 1st week of December |
| JNKVV, Jabalpur | JS20-98 | 3rd to 4th week of December |
| MPKV, Rahuri | Phule Durva and Phule Sangam | 3rd week of January |
| PDKV, Akola | PDKV Amba and Suvarna Soya | -NA- |
| UAS, Raichur | JS-335 | -NA- |

**The detailed mean data over locations is presented below:**

**A. Effect of seed treatments on plant growth, seed yield, seed quality and economic attributes in off-season soybean:**

Among the different treatments, T3 (Salicylic Acid@800ppm) exhibited better performance in terms of field emergence (86.2 %), plant stand establishment/$m^2$ (32.7), no. of pods/plant (50), seed yield (17.9 g/plant, 2.9 kg/plot and 25.5 q/ha) along with highest seed recovery (81%). The same treatment was also found superior in terms of economic indicators i.e., net monetary returns (Rs. 115060) and BC ratio (3.2). However, T2 (Salicylic Acid@400ppm) was effective with respect to nodules/plant (26.8), leaf chlorophyll content (SPAD value - 38.7), plant height at 30 DAS (28.9) and harvest (50.3) along with seed quality attributes viz., germination (89.6%) and vigor index I (2308).

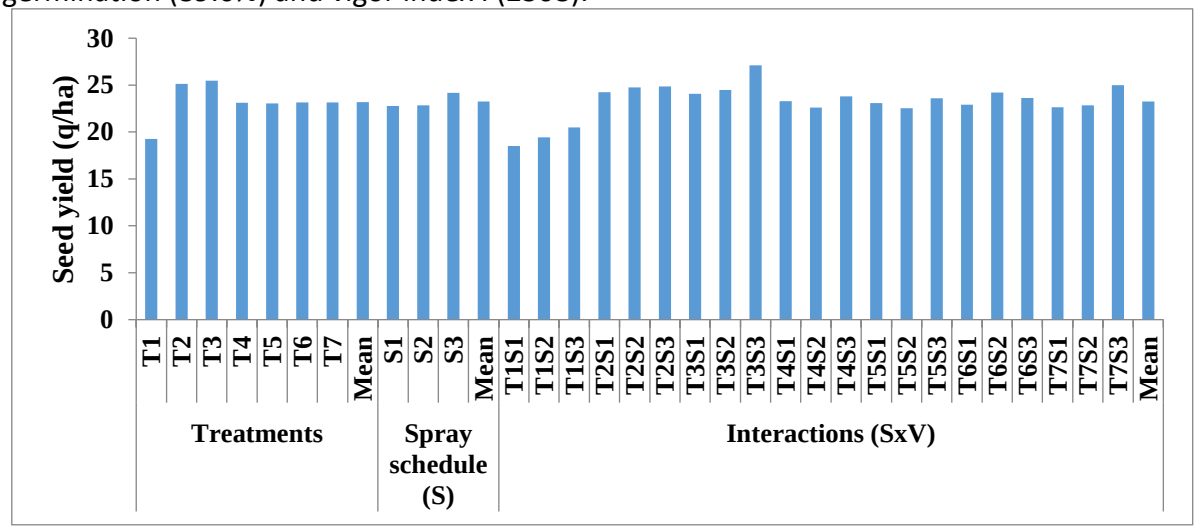



**Fig. 1.36: Effect of seed treatments on seed yield in off-season soybean**

**B. Effect of spray schedule on plant growth, seed yield, seed quality and economic attributes in off-season soybean:**

Among the different spray schedules, S3 (Both flowering and vegetative stage) recorded highest plant stand establishment/$m^2$ (32), no. of nodules/plant (25.9), leaf chlorophyll content (SPAD value: 37.7), plant height at 30 DAS and harvest (28.1 cm and 50.3 cm), no. of pods/plant (46.4) with seed yield (17.1 g/plant, 2.6 kg/plot and 24.2 q/ha), including 1000 seed test weight (113.9), germination (89.4 %), seed recovery (80.6) as well as economic attributes viz., net monetary returns (Rs. 112301) and BC ratio (2.9). The interactions could not be compared as the varieties selected for this experiment were different for the different centres. Therefore, mean over locations could not be prepared.

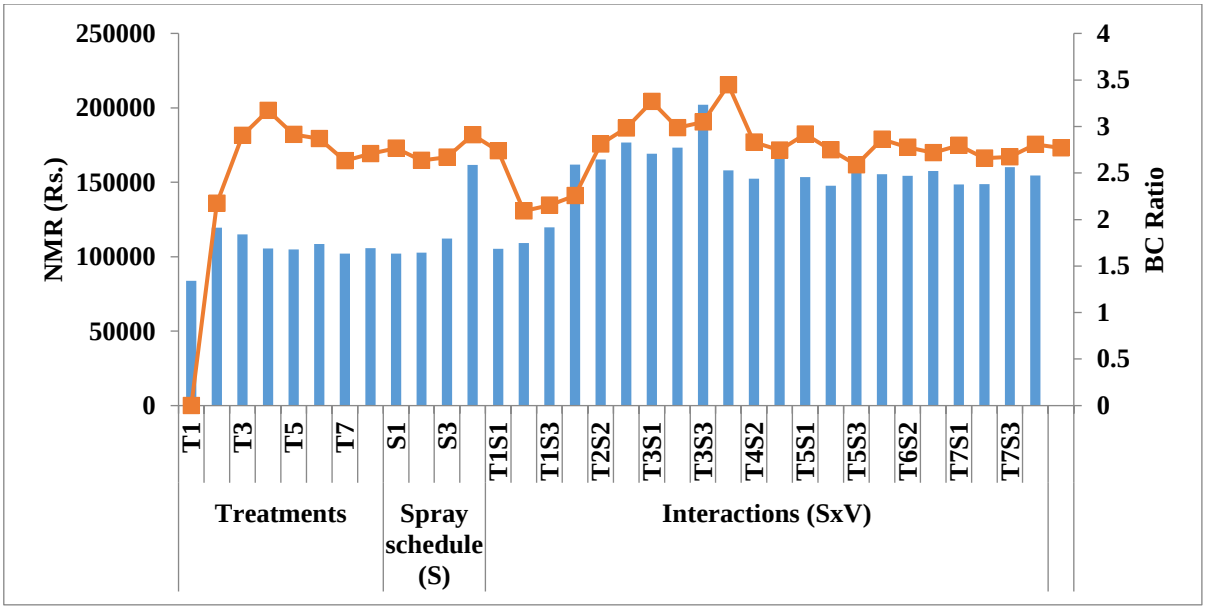



**Fig. 1.37: Effect of seed treatments on economic attributes in off-season soybean**

**Significant Observation:** T3 (Salicylic Acid@800ppm) scheduled at S3 (Both flowering and vegetative stage) resulted in significant increase in field emergence, plant growth, seed yield and quality attributes as well as net monetary returns and BC ratio.

**Conclusion: Salicylic Acid @800ppm spray at vegetative and flowering stages,** followed by **Salicylic Acid @400ppm** was effective in improving the plant growth and seed yield during off season seed production of soybean and hence, ensuring higher net monetary returns and BC ratio to the farmers.




**Fig. 1.38: Experimental plot view at UAS Raichur**

**Experiment 6: To study the status of informal seed sector at farmer level: An analytical survey**

India's informal seed sector plays a vital role in ensuring seed security, particularly for small and marginal farmers who rely on farm-saved seeds, local exchanges and community networks. Despite the expansion of the formal seed system, informal seed sources continue to support crop adaptability, affordability and conservation of local agro biodiversity. However, limited documentation and lack of quality regulation raise concerns regarding seed purity and viability. Therefore, the present study was undertaken to assess farmer-level seed sourcing, saving, exchange practices and seed quality parameters across different agro-climatic regions of India through a large-scale analytical survey conducted at All India Coordinated Research Project on Seed centres.

**Objectives:**

1. To assess the extent, practices, and trends of seed sourcing, saving, and exchange among farmers within the informal seed sector.
2. To analyze the quality, varietal diversity, and reliability of seeds used by farmers outside the formal system.
3. To identify the key challenges, opportunities, and policy gaps related to the informal seed sector at the grassroots level.

**The following centres submitted the data**

| S. No. | Centre | Survey data | Seed testing data |
|---|---|---|---|
| 1. | RPCAU, Bihar | Submitted | Not submitted |
| 2. | UAS-B, Bengaluru | Not submitted | S (Multiple crops included) |
| 3. | AAU, Anand | Not submitted | Submitted |
| 4. | VNMKV, Parbhani | Submitted | Submitted |
| 5. | UBKV, Pundibari | Submitted | Not submitted |
| 6. | PAU, Ludhiana | Submitted | Not submitted |
| 7. | AAU, Jorhat | Not submitted | Submitted |

| | | | |
|---|---|---|---|
| 8. | IGKV, Raipur | Not submitted | Submitted |
| 9. | ANGRAU, Guntur | Submitted | Submitted |
| 10. | CSAUAT, Kanpur | Submitted | Submitted |
| 11. | CSKHPKV, Palampur | Submitted | Submitted |
| 12. | HAU, Hisar | Submitted | Submitted |
| 13. | TNAU, Coimbatore | Submitted | S (Multiple crops included) |
| 14. | PDKV, Akola | Submitted | S (Multiple crops included) |
| 15. | ICAR-IARI, New Delhi | Submitted | Submitted |
| 16. | ICAR-NISST, Mau | Submitted | Submitted |
| 17. | JNKVV, Jabalpur | Submitted | S (Multiple crops included) |
| 18. | PAJANCOA&RI, Karaikal | Not submitted | Submitted |
| 19. | OUAT, Bhubaneswar | Submitted | Submitted |
| 20. | ICAR RC NEH Lamphelpat | Submitted | Submitted |
| 21. | MPKV, Rahuri | Submitted | S (Multiple crops included) |
| 22. | ICAR RC NEH AP | Submitted | Submitted |

**Results**

**1. Acharya N. G. Ranga Agricultural University (ANGRAU)**

**Paddy (n=100)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 88.70 | ≥80 | 84 | 84 |
| Physical Purity (%) | 92.4 | ≥98 | 01 | 01 |
| Moisture (%) | 9.0 | ≤13 | 100 | 100 |

**Maize (n=100)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 98.5 | ≥90 | 100 | 100 |
| Pure Seed (%) | 98.5 | ≥98 | 82 | 82 |
| Moisture (%) | 9.3 | ≤12 | 100 | 100 |

The results revealed that seed quality was better in maize compared to paddy. Paddy seeds recorded high germination (88.7%) and safe moisture levels (9.0%); however, physical purity was poor, with only 1% of the samples meeting the prescribed standards. In contrast, maize seeds performed well for all the parameters, viz. high germination (98.5%), good purity (98.5%), and acceptable moisture content (9.3%). These findings indicate that the informal maize seed system maintained better seed quality, whereas paddy seeds require improved cleaning and grading practices.

**2. Chandra Shekhar Azad University of Agriculture and Technology (CSAUAT)**

**Field pea (n=200)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Germination (%) | 87.40 | ≥75 | 200 | 100 |
| Pure Seed (%) | 96.89 | ≥98 | 44 | 22 |
| Moisture (%) | 8.82 | ≤9 | 64 | 32 |

The results for indicated high seed germination, with an average germination of 87.4%, and all samples confirmed to minimum standard of 75%. However, seed purity was below the minimum standards, with only 22% of samples meeting the prescribed purity level (98%). Seed moisture content was close to the permissible limit, but only 32% of seed samples conformed to the prescribed standards. Hence, it can be concluded that, while seed viability was satisfactory, improvements are required in seed cleaning, processing and storage practices.

### 3. CSK Himachal Pradesh Krishi Vishvavidyalaya (CSKHPKV)

**Wheat (n=142)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 91.15 | ≥85 | 131 | 92.25 |
| Pure Seed (%) | 99.44 | ≥98 | 135 | 95.07 |
| Moisture (%) | 14.96 | ≤12 | 01 | 0.70 |

**Maize (n=122)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 86.17 | ≥90 | 48 | 39.34 |
| Pure Seed (%) | 99.84 | ≥98 | 121 | 99.18 |
| Moisture (%) | 12.99 | ≤12 | 28 | 22.95 |

The results exhibited contrasting seed quality characteristics between wheat and maize. Wheat seeds performed better in terms of germination (91.15%) and physical purity (99.44%), with more than 90% of seed samples meeting the minimum standards. However, the moisture content was relatively high (14.96%), and only 0.7% of the samples met the prescribed limits, indicating poor storage conditions. In maize, seed purity was excellent (99.84%); however, germination was below the minimum standard, with only 39.34% of samples meeting the prescribed germination criterion. Seed moisture content was also higher than the permissible limit, and only 22.95% of samples conformed to the moisture standard. These findings suggest that although physical purity was well maintained, inadequate drying and improper storage conditions adversely affected seed viability and overall seed quality in maize.

### 4. Chaudhary Charan Singh Haryana Agricultural University (Hisar Agricultural University)

**Wheat (n=199)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 85.83 | ≥85 | 133 | 66.83 |
| Pure Seed (%) | 96.73 | ≥98 | 89 | 44.72 |
| Moisture (%) | 10.54 | ≤12 | 174 | 87.44 |

**Mustard (n=100)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 86.32 | ≥70 | 96 | 96 |
| Pure Seed (%) | 96.20 | ≥97 | 52 | 52 |
| Moisture (%) | 8.02 | ≤8 | 47 | 47 |

**Paddy (n=100)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 75.58 | ≥80 | 39 | 39 |
| Pure Seed (%) | 96.75 | ≥98 | 29 | 29 |
| Moisture (%) | 11.35 | ≤13 | 100 | 100 |

The results indicated varying seed quality across the crops. Wheat seeds recorded acceptable germination (85.83%) and moisture content (10.54%), but seed purity was below the minimum standard, with only 44.72% of samples meeting the prescribed levels. Mustard seeds fared relatively well, with high germination (86.32%), while purity and moisture standards were conformed in only about half of the samples, indicating issues pertaining to seed processing and storage. Paddy seeds exhibited comparatively poor performance, with low germination (75.58) and purity (96.75%), and only 39% and 29% of seed samples meeting the prescribed standards. However, moisture level was found to be acceptable in all the paddy samples. Overall, the findings suggest that moisture content was generally satisfactory, but seed purity and germination, particularly in paddy, require improvement in the informal seed system.

**5. Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV)**

**Soybean (n=96)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 35.85 | ≥70 | 15 | 15.62 |
| Pure Seed (%) | 98.26 | ≥98 | 79 | 82.29 |
| Moisture (%) | 12.54 | ≤12 | 48 | 50 |

The results showed poor seed quality of soybean in the informal seed sector. Seed germination was very low (35.85%), with only 15.62% of samples meeting the minimum standard (70%), indicating serious loss of seed viability. However, seed purity was comparatively better, with 82.29% of samples meeting the prescribed standards. Seed moisture content was slightly above the permissible limit, and only half of the samples conformed to the minimum standard. Overall, the findings suggest that improper storage and handling practices adversely affected soybean seed viability in the informal seed system.

### 6. ICAR-National Institute of Seed Science and Technology (ICAR-NISST)

**Paddy (n=200)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 85.16 | ≥80 | 168 | 84 |
| Pure Seed (%) | 98.44 | ≥98 | 163 | 81.5 |
| Moisture (%) | 11.90 | ≤13 | 196 | 98 |

**Wheat (n=200)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 81.85 | ≥85 | 115 | 57.50 |
| Pure Seed (%) | 98.79 | ≥98 | 172 | 86 |
| Moisture (%) | 10.82 | ≤12 | 192 | 96 |

The results indicated relatively good seed quality in the informal seed sector. Paddy seeds exhibited satisfactory seed quality, with high germination (85.16%), high seed purity (98.44%) and safe moisture content (11.90%), as most seed samples met the prescribed standards. Wheat seeds also recorded good seed purity (98.79%) and lower seed moisture content (10.82%). However, germination was slightly below the prescribed standard, with only 57.5% of the samples meeting the minimum germination criterion. Overall, the findings suggest that seed processing and storage practices were generally effective, although improvement in is still required for the maintenance of seed viability in wheat.

### 7. VNMKV, Parbhani

**Soybean (n=94)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 87.42 | ≥70 | 94 | 100 |
| Pure seed (%) | 98 | ≥98 | 94 | 100 |
| Moisture (%) | 14.33 | ≤12 | 57 | 59.38 |

The data revealed high germination (87.42%) and seed purity (98.00%) in soybean seeds, with all samples meeting the prescribed standards. However, seed moisture content was higher than the permissible limit, and only 59.38% of the samples conformed to the minimum standard. The findings indicate overall good seed quality, but improved drying and storage practices are required to reduce excess moisture for the maintenance of seed viability during storage.

### 8. Indira Gandhi Krishi Vishwavidyalaya (IGKV)

**Paddy (n=62)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 85.54 | ≥80 | 62 | 100 |
| Pure seed (%) | 98.78 | ≥98 | 61 | 98.38 |
| Moisture (%) | 11.22 | ≤13 | 55 | 88.71 |

The results indicated good seed quality in paddy samples in the informal seed sector. Germination (85.54 %), purity (98.78%) and seed moisture content (11.22%) were found to be meeting the prescribed standards, with most samples conforming to the minimum criteria. These findings suggest that farmers generally adopted effective seed handling, processing, and storage practices, which helped maintain satisfactory seed quality.

### 9. Anand Agricultural University (AAU, Anand)

**Paddy (n=34)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 85.54 | ≥80 | 62 | 100 |
| Pure seed (%) | 98.78 | ≥98 | 61 | 98.38 |
| Moisture (%) | 11.22 | ≤13 | 55 | 88.71 |

**Wheat (n=121)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 85.93 | ≥85 | 84 | 69.42 |
| Pure seed (%) | 99.87 | ≥98 | 121 | 100 |
| Moisture (%) | 10.89 | ≤12 | 112 | 92.56 |

The results indicated satisfactory seed quality in the informal seed sector. Paddy seeds showed high seed germination (86.47%) as well as purity (98.62%), including safe moisture levels (10.97%), with most samples meeting the prescribed standards. Similarly, wheat seeds recorded good germination (85.93%), excellent purity (99.87%), and acceptable moisture content (10.89%). Overall, the findings suggest effective seed production, processing, and storage practices among farmers in the informal seed system.

### 10. AAU Assam

**Paddy (n=100)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 81.79 | ≥80 | 91 | 91 |
| Pure seed (%) | 88.98 | ≥98 | 0 | 0 |
| Moisture (%) | 11.91 | ≤13 | 91 | 91 |

The results indicated that paddy seeds in the informal seed sector had acceptable germination (81.79%) and safe moisture content (11.91%), with 91% of samples meeting the prescribed standards. However, seed purity was considerably low (88.98%), and none of the samples met the prescribed purity standard. These findings suggest serious deficiencies in seed cleaning and processing practices, despite satisfactory seed viability and storage conditions.

### 11. ICAR-Indian Agricultural Research Institute (ICAR-IARI)

**Paddy (n=100)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 59 | ≥80 | 28 | 28 |
| Pure seed (%) | 99 | ≥98 | 82 | 82 |
| Moisture (%) | 14 | ≤13 | 38 | 38 |

**Wheat (n=40)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 85 | ≥85 | 27 | 67.5 |
| Pure seed (%) | 99 | ≥98 | 32 | 80 |
| Moisture (%) | 12 | ≤12 | 26 | 65 |

The results revealed mixed trends with respect to seed quality status of the wheat and paddy samples collected from the informal seed sector. Paddy seeds recorded poor germination (59%) and high moisture content (14%), with only 28% and 38% of samples meeting the prescribed standards, respectively, indicating low seed viability and inadequate storage conditions. However, seed purity was relatively high (99%), with most samples meeting the minimum standard. However, the quality of wheat seeds was observed to be comparatively better, with satisfactory germination (85%) and high seed purity (99%). Nevertheless, seed moisture content remained higher than the prescribed limit, as only 65% of the samples conforming to the minimum standard. Overall, the findings suggest that although seed purity was well maintained, improved drying and storage practices are needed, particularly for paddy seeds.

### 12. ICAR RC NEH, Manipur, Lamphelpat

**Paddy (n=200)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 93.02 | ≥80 | 198 | 99 |
| Pure seed (%) | 89.27 | ≥98 | 19 | 9.5 |
| Moisture (%) | 13.16 | ≤13 | 115 | 57.5 |

The results showed that paddy seeds recorded high germination (93.02%), with 99% of the samples meeting the prescribed standard. Seed moisture content was slightly above the prescribed standard (13.16%), although 57.5% of the samples were within the acceptable limit.

However, seed purity was comparatively low (89.27%), and only 9.5% of the samples met the required purity standard, indicating deficiencies in seed cleaning and processing practices.

### 13. OUAT, Bhubaneshwar

**Paddy (n=150)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 76.19 | ≥80 | 62 | 41.33 |
| Pure seed (%) | 99.0 | ≥98 | 139 | 92.67 |
| Moisture (%) | 12.09 | ≤13 | 133 | 88.67 |

The results from showed that paddy seeds purity (99.0%) and moisture content (12.09%) were within the prescribed limit, with 92.67% and 88.67% of samples, respectively conforming to the minimum criteria. However, germination percentage was comparatively low (76.19%), and only 41.33% of samples met the prescribed germination standard, indicating reduced seed viability on account of inadequate storage and seed handling practices.

### 14. PAJANCOA&RI, Karaikal

**Paddy (n=153)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 39 | ≥80 | 31 | 20.26 |
| Pure seed (%) | 91 | ≥98 | 66 | 43.14 |
| Moisture (%) | 13 | ≤13 | 45 | 29.41 |

The results from the Karaikal centre indicated poor seed quality, with low germination (39%) and seed purity (91%), as only 20.26% and 43.14% of paddy seed samples, respectively conforming to the prescribed standards. Although the mean seed moisture content was within the acceptable limit (13%), only 29.41% of samples fulfilled the prescribed standard, indicating inadequate drying and storage conditions.

### 15. ICAR RC NEH, Arunachal Pradesh Centre

**Paddy (n=200)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 75.12 | ≥80 | 122 | 61 |
| Pure seed (%) | 53.24 | ≥98 | 0 | 0 |
| Moisture (%) | 6.52 | ≤13 | 200 | 200 |

**Maize (n=200)**

| Seed Quality parameter | Mean value | Minimum standards | No. of seed samples conforming to IMSCS | Percentage of seed samples conforming to IMSCS (%) |
|---|---|---|---|---|
| Germination (%) | 77 | ≥90 | 62 | 31 |

| | | | | |
|---|---|---|---|---|
| Pure seed (%) | 82.85 | ≥98 | 19 | 9.5 |
| Moisture (%) | 6.61 | ≤12 | 200 | 100 |

The results indicated poor seed quality status in paddy samples. Seed germination was observed to substandard (75.12%), with only 61% of the samples conforming to the minimum germination standard. Seed purity was extremely low (53.24%), and none of the samples fulfilled the prescribed purity standard, indicating serious issues in seed cleaning and processing. However, seed moisture content remained well within the acceptable limit (6.52%), with all samples complying with the prescribed moisture standard. Similarly, overall seed quality in maize samples was not satisfactory Germination percentage was comparatively low (77%), with only 31% of the samples meeting the prescribed seed standard. Seed purity was also poor (82.85%), and merely 9.5% of the samples complied with the minimum purity requirement, suggesting inadequate seed processing and handling practices. Nevertheless, seed moisture content (6.61%) was within the acceptable range, and all samples satisfied the prescribed moisture standard.

**Conclusion**

Overall, the study revealed considerable variation in seed quality status across crops and locations in the informal seed sector. Most seed samples recorded acceptable germination and moisture content, indicating that farmers were generally able to maintain seed viability and adopt proper storage practices. However, seed purity emerged as a major concern in several cases, particularly in paddy, where many samples failed to meet the prescribed standards due to inadequate seed processing facilities. Maize, wheat, and soybean performed comparatively better in some centres, whereas poor germination and high moisture content were observed in others, reflecting improper storage and handling practices. The findings highlight the important role of the informal seed sector in ensuring seed supply to farmers despite certain quality limitations. Strengthening farmers' awareness and providing training on seed processing, handling, and storage practices can significantly contribute to improving and maintaining seed quality in the informal seed system

## B. Seed Physiology, Storage and Testing

**Experiment 1: To reaffirm the validity periods of certified seeds of field crops (as per IMSCS regulations)**

| S. No | Centre | Crop | Varieties | Remarks | Conclusion |
|---|---|---|---|---|---|
| **Green gram:** JNKVV, Jabalpur; PAU, Ludhiana; PAJANCOA & RI, Karaikal; AAU, Jorhat; SKNAU, Jobner; UAS, Raichur | | | | | |
| 1 | JNKVV, Jabalpur | Green gram | ML 2056; Virat | The germination % acceptable as per IMSCS was recorded till August, the 6$^{th}$ month of storage, with a mean germination of 84.75%, exceeding the minimum acceptable level of 75%. However, germination dropped sharply to 71.33% in September, indicating that the seed lot maintained acceptable germination only up to 6 months of storage. | Gunny bag storage up to 6 months<br>HDPE bag storage up to 6 months, maintained germination % above IMSCS in both cultivars. |
| 2 | PAU, Ludhiana | Green gram | ML 2056; Virat | Germination remained consistently high throughout the 7 months of storage, ranging from 96.0% to 98.8% across storage periods. The mean germination was almost identical in cloth bags (97.5%) and HDPE bags (97.4%), indicating no practical difference between the two packing materials. | Seeds of both the mungbean varieties, i.e. ML 2056 and Virat, stored in HDPE bags as well as cloth bags, recorded germination higher than IMSCS (75 %) after seven months of storage. |
| 3 | PAJANCOA & RI, Karaikal | Green gram | ML 2056; Virat | No. of months with seed germination ≥ IMSCS from the date of 1$^{st}$ test is 8 and 9 months in cloth | Seed germination in Green gram varieties was maintained as per IMSCS for |

| | | | | | |
|---|---|---|---|---|---|
| | | | | and HDPE bags, respectively, in variety ML 2056. Whereas, 6 and 8 months in the variety Virat. | 8-9 months from the date of the 1st test in an HDPE bag, and for 6-8 months in a cloth bag, under the coastal environmental conditions of Karaikal district. |
| | | | |  | |
| 4 | AAU, Jorhat | Green gram | ML 2056; Virat | The germination percentage of both varieties declined progressively with the advancement of the storage period. Initially, germination was 92% in ML 2056 and 85% in Virat. HDPE bags slightly better at moisture control. Variety, ML 2056, is slightly more storage-tolerant than variety, Virat. | IMSCS for germination (>75%) is maintained by both varieties for up to 4 months under both packaging materials, whereas ML2056 is maintained for up to 5 months under HDPE bags. |

| | | | | | |
|---|---|---|---|---|---|
| 5 | SKNAU, Jobner | Green gram | ML 2056; Virat | No. of months with seed germination ≥ IMSCS from the date of the 1st test is 7 and 8 months in cloth and HDPE bags, respectively, in variety ML 2056. Whereas, 4 and 6 months in the variety Virat. | Cloth bags: 4 to 7 months<br>HDPE bags: 6 to 8 months |
| 6 | UAS, Raichur | Green gram | ML 2056; Virat | After eight months of storage, the seeds of green gram varieties, Virat, maintained the minimum seed quality standards in both HDPE and cloth bags. In contrast, the ML 2056 variety showed a significant reduction in seed quality under both HDPE and cloth bags storage conditions after 3 months of storage due to bruchid infestation. | Virat variety:<br>Cloth bags: 8* months<br>HDPE bags:8* months<br>(Still continuing) |
| | | | | <br>**Insect infestation after 8 months of storage of ML 2056 seed lots in cloth bag and HDPE bag at Seed Unit, UAS, Raichur** | |

| | | | | | |
|---|---|---|---|---|---|
| **Sesame: RPCAU, Pusa; SKNAU, Jobner; TNAU,Coimbatore; PAU, Ludhiana; VNMKV,Parbhani** | | | | | |
| 1 | RPCAU, Pusa | Sesame | AKT -64 | After 6 months of storage, the seeds of AKT-64 maintained the germination % well above IMSCS in both cloth and HDPE bags. | Cloth bags: 6* months<br>HDPE bags:6* months<br>(*Still continuing) |
| 2 | SKNAU, Jobner | Sesame | AKT -64 | The results revealed that the germination percentage of 3 month old seed lots declined below the IMSCS standard (80%) in jute bags for the variety AKT-64 (78.75%), whereas in HDPE bags, the germination percentage dropped below IMSCS after 7 months in the same variety. | Cloth bags: 3 months<br>HDPE bags:7 months |
| 3 | TNAU, Coimbatore | Sesame | AKT -64 | During the initial period, the sesame seeds achieved 90% germination in both cloth and HDPE bags. As the storage period increased, germination gradually declined. At the final storage period ($P_6$), germination decreased to 85% in cloth bag and 88% in HDPE bag, with a mean of 87%. The overall mean germination was 88% in cloth bag and 90% in HDPE bag, with a treatment mean of 89%, although the differences were statistically non-significant | Cloth bag: 6* months<br>HDPE bag: 6* months<br>(*Still continuing) |
| | | | | | |

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| | | | |   *Germination & Field Emergence observation: Six months after storage - sesame AKT 64-Cloth bag* | |
| 4 | PAU, Ludhiana | Sesame | AKT -64 | Seeds of the sesame variety AKT-64 stored in HDPE as well as cloth bags recorded germination (%) higher than the Indian Minimum Seed Certification Standards of 80 % after six months of storage. | Cloth bag: 6* months<br>HDPE bag: 6* months<br>(*Still continuing) |
| 5 | VNMKV,Parbhani | Sesame | AKT -64; TLT 10 | During storage, seeds in HDPE bags consistently showed higher germination (up to 93.25%) than those in gunny bags.<br>A gradual decline in germination was observed with advancement of storage period in all treatments. After 6–7 months, germination decreased to 82.00–85.25%. However, AKT 64 stored in HDPE bags maintained comparatively higher germination (85.25% at 6 months and 84.00% at 7 months). | Cloth bag: 7* months<br>HDPE bag: 7* months<br>(*Still continuing) |

| | | | | | |
|---|---|---|---|---|---|
| **Linseed: SHUATS, Prayagraj; RPCAU, Pusa; AU, Kota; PDKV, Akola** | | | | | |
| 1 | SHUATS, Prayagraj | Linseed | NL – 260; KBA 4 | HDPE bags consistently retained higher germination than cloth bags. In NL-260, germination declined from an initial 98%, with a slower reduction under HDPE storage. In KBA-4, germination declined from 96%, and the reduction was more pronounced under cloth-bag storage. Overall, HDPE bags were superior for preserving germination, while NL-260 showed better storability than KBA-4. | Cloth bag: 6* months<br>HDPE bag: 6* months<br>(*Still continuing) |
| | | | | <br>*Germination Percentage observed after 6 months of storage in Linseed* | |
| 2 | RPCAU, Pusa | Linseed | KBA 4 & KBA 6 | Both linseed varieties maintained fairly high germination during storage. In Kota Barani Alsi-4, | Cloth bag: 5* months<br>HDPE bag: 5* months<br>(*Still continuing) |

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| | | | | germination declined slightly from an initial mean of 90.7% to 88.0% in HDPE bag and 86.7% in cloth bag by March 2026. HDPE bag showed better retention of germination than cloth bag in KBA-4. In Kota Barani Alsi-6, initial germination was 87.3%, and the final germination in March 2026 was 86.7% in HDPE bag and 87.7% in cloth bag. Overall, germination remained above 86% in both varieties, indicating good seed viability up to March 2026. | |
| 3 | AU, Kota | Lin seed | NL-260; KBA-4; KBA-6 | Among the varieties, NL-260 showed comparatively better germination retention, particularly under HDPE storage, retaining 84.00% germination after 8 months. KBA-4 recorded the sharpest decline, falling to 69.25% in gunny bag and 73.75% in HDPE bag by April 2026. | Cloth bag: 6 months<br>HDPE bag: 6 months<br>However, NL 260 still retains germination above 80 % after 8 months of storage |
| 4 | PDKV, Akola | Lin seed | NL-260; KBA-4; KBA-6 | Initial germination in July 2025 was highest in NL-260 (97%), followed by KBA-6 (91%) and KBA-4 (89.5%). Under cloth-bag storage, germination declined through March, with values of 82% in NL-260, 85% in KBA-4, and 83% in KBA-6. Under HDPE bag storage, final | Cloth bag: 8* months<br>HDPE bag: 8* months<br>(*Still continuing) |

| | | | | | |
|---|---|---|---|---|---|
| | | | | germination was slightly better, recording 83% in NL-260, 86% in KBA-4 and 85% in KBA-6. Overall, HDPE bags showed marginally better retention of germination than cloth bags, particularly in KBA-4 and KBA-6. | |
| **Cowpea: KSNUAHS, Shivamogga; OUAT, Bhubaneshwar; TNAU, Coimbatore; BSKKV, Dapoli; GBPUAT, Pantnagar** | | | | | |
| 1 | KSNUAHS, Shivamogga | Cowpea | UAHS-28; GP-1 | Mean germination in cloth bags declined from 93.74% to 92.16%, whereas in HDPE bags it declined from 96.99% to 93.96%. | Cloth bag: 3* months<br>HDPE bag: 3* months<br>(*Still continuing) |
| 2 | OUAT, Bhubaneshwar | Cowpea | UAHS-28; GP-1 | Seed germination declined gradually with the advancement in storage period from 0 to 3 months in both varieties. GP 1 recorded slightly higher germination than UAHS-28 at all storage intervals. Germination in GP 1 declined from 88.25% to 85.88%, while in UAHS-28 declined from 87.50% to 85.00%. The reduction was marginal, indicating that both varieties maintained good seed viability up to 3 months of storage. | Cloth bag: 3* months<br>HDPE bag: 3* months<br>(*Still continuing) |
| 3 | TNAU, Coimbatore | Cowpea | UAHS-28; GP-1 | During the initial storage period, UASH 28 recorded 88% germination, whereas GP 1 recorded 90% in both containers. After two months of storage, UASH 28 recorded 87% in a | Cloth bag: 2* months<br>HDPE bag: 2* months<br>(*Still continuing) |

| | | | | | |
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| | | | | cloth bag and 88% in an HDPE bag, while GP 1 recorded 89% and 90%, respectively. | |
| | | | |  *Germination after two months of storage of cowpea GP1 -Cloth bag* | |
| 4 | BSKKV, Dapoli | Cowpea | UAHS-28; GP-1 | In Progress | |
| 5 | GBPUAT, Pantnagar | Cowpea | UAHS-28; GP-1 | In Progress | |
| **Little Millet: JNKVV, Jabalpur; SHUATS, Prayagraj; OUAT, Bhubaneshwar; UAS Raichur** | | | | | |
| 1 | JNKVV, Jabalpur | Little millet | JK-95 | Maintained seed germination above IMSCS (≥75%) up to the 6th month of storage after testing. Seed germination deteriorated rapidly from the $7^{th}$ month of storage, recording a mean value of 38.50%. It declined further to 23.66% in the $9^{th}$ month, indicating a severe deterioration in seed viability under extended storage. | Cloth bag: 6 months<br>HDPE bag: 6 months |
| 2 | SHUATS, Prayagraj | Little millet | JK-95 | Seed germination of JK 95 declined gradually during storage from August 2025 to February 2026. The | Cloth bag: 6* months<br>HDPE bag: 6* months<br>(*Still continuing) |

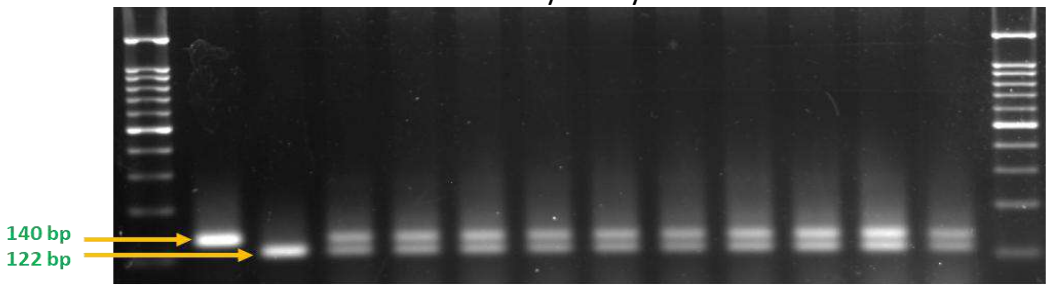
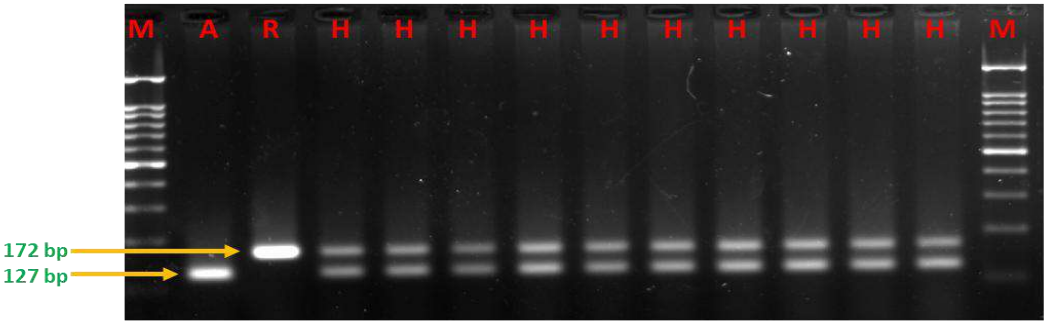
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| | | | | decline was more pronounced in cloth bags, where germination reduced from 97% to 89%, compared to HDPE bags, where it reduced from 97% to 90%. HDPE bags maintained slightly higher germination than cloth bags at all later storage intervals. | |
| 3 | OUAT, Bhubaneshwar | Little millet | JK-95 | Seed germination declined progressively from 0 to 8 months of storage. In cloth bags, germination decreased from 86.75% to 75.50%, showing a sharper loss of viability. In HDPE bags, germination declined more slowly from 86.75% to 80.50%. Overall, HDPE bag storage was superior for retaining seed germination during prolonged storage up to 8 months. | Cloth bag: 8* months<br>HDPE bag: 8* months<br>(*Still continuing) |
| 4 | UAS Raichur | Little millet | HS 1 | After 2 month of seed storage, seeds stored in HDPE bag recorded highest seed quality parameters (94 % HDPE bag and 93.5 % in cloth bags) | Cloth bag: 2* months<br>HDPE bag: 2* months<br>(*Still continuing) |
| **Proso millet: TNAU, Coimbatore; RPCAU, Pusa; UAS, Dharwad; UAS, Bengaluru; GBPUAT, Pantnagar and SHUATS, Prayagraj** | | | | | |
| 1 | TNAU, Coimbatore | Proso millet | GPUP 25; GPUP 28 | Prosomillet variety GPUP 25 (75 %) and GPUP 28 (75 %) seeds stored in HDPE bag maintained the IMSCS recommended germination (75 %) and seed quality parameters up to 13 months and 11 months, | Cloth bag: 8-10 months<br>HDPE bag: 11-13 months |

| | | | | | |
|---|---|---|---|---|---|
| | | | | respectively but GPUP 25and GPUP 28 seeds stored in gunny bag maintained the germination of 75per cent up to 10 months and 8 months, respectively. Prosomillet variety GPUP 25 showed an extended storage period of two months compared to GPUP 28. | |
| 2 | RPCAU, Pusa | Proso millet | GPUP 25; GPUP 28 | The data from the current experiment showed that both the varieties GRUP-25 and GRUP-28 maintained seed quality above IMSCS for 12 months when stored in cloth bags and for 13 months when stored in HDPE bags from the date of first test. | Cloth bag: 12 months<br>HDPE bag: 13 months |
| 3 | UAS, Dharwad | Proso millet | DHPM-2769; GPUP 25; GPUP 28 | Among the varieties DHPM-2769 was recorded significantly higher First count, seed germination and seed vigour index and maintained higher germination percentage till date (16months) followed by the GPUP-28 and GPUP-25 variety | Cloth bag: 16 months<br>HDPE bag: 13 months |
| 4 | UAS, Bengaluru | Proso millet | GPUP 25; GPUP 28 | Germination was recorded above IMSCS up to 10 and 11 months of storage in varieties GPUP-25 in cloth bag and HDPE bag, respectively whereas in GPUP-28 up to 11 & 12 | Cloth bag: 10-11 months<br>HDPE bag: 11-12 months |

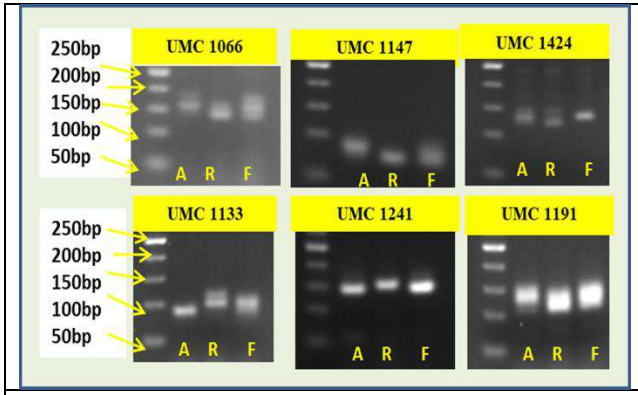
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| | | | | months of storage in cloth bag and HDPE bag. | |
| 5 | GBPUAT, Pantnagar | Proso millet | GPUP 25; GPUP 28 | Seed germination in a cloth bag (74.9%) was maintained up to 11 months of storage, whereas in an HDPE bag (75.2%) it was maintained up to 15 months of storage. | Cloth bag: 11 months<br>HDPE bag: 15 months |
| 6 | SHUATS, Prayagraj | Proso millet | GPUP 25; GPUP 28 | Seed quality parameters declined progressively in both GPUP25 and GPUP28 from April 2025 to February 2026 under both packing materials. By February 2026, germination in cloth bags fell below the 75% standard in both GPUP25 (71.18%) and GPUP28 (74.08%), whereas HDPE retained higher germination of 81.39% and 84.71%, respectively. Among the two genotypes, GPUP28 showed better storability. | Cloth bag: 6-8 months<br>HDPE bag: 10 months |

**Experiment 2: Hybrid purity testing using molecular markers in public sector hybrids of field crops**

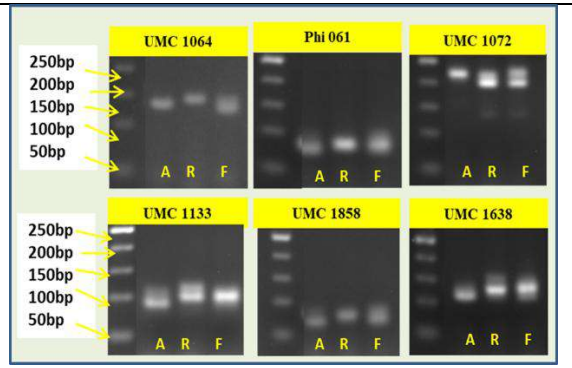
| S. No | Centre | Hybrids | SSR markers identified and remarks |
|---|---|---|---|
| **1. Identification of microsatellite markers for establishing hybridity in additional/new hybrids** | | | |
| **Paddy: JNKVV, Jabalpur; RPCAU, Pusa and ICAR-NISST, RS Bengaluru** | | | |
| 1 | ICAR-NISST, RS Bengaluru | JRH 135 | Crop – Rice<br>Hybrid – JRH 135 from JNKVV, Jabalpur |

| | | | |
|---|---|---|---|
| | | | No. of SSR markers (RM series) used for parental polymorphism- 220<br>No. of polymorphic markers – 3<br>Among the polymorphic markers, RM-212 clearly distinguished the parents and hybrid, which can be effectively used for molecular purity analysis of the hybrid JRH-135.<br>In addition to that, the marker RMS- SF21 identified at AICRP on Seed (Crops), JNKVV, Jabalpur also validated for its use in the molecular hybridity test of JRH-135<br><br><br>**RM 212**<br><br><br>**RMS- SF21**<br>M - Ladder (100 bp); A - Male sterile line; R – Restorer line; H - Hybrid (JRH-135) |
| **Maize: UAS, Bengaluru; PAU, Ludhiana and RPCAU, Pusa** | | | |

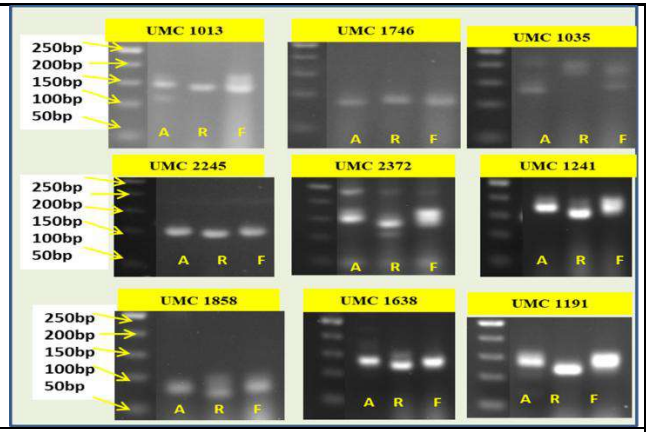
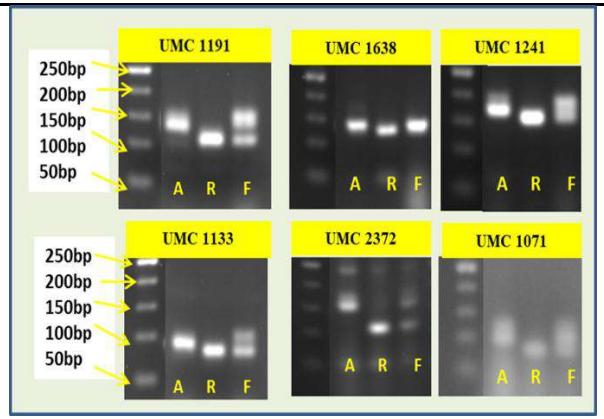
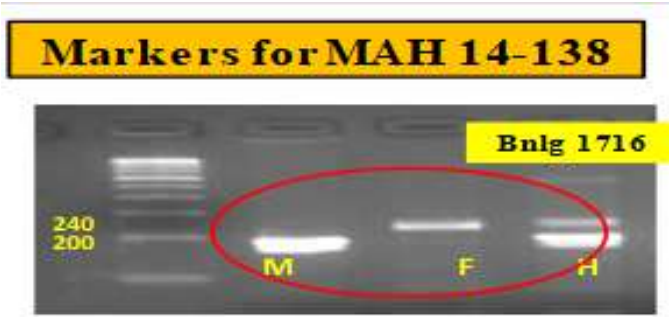
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| 1 | RPCAU, Pusa | Shaktiman-1; Shaktiman-2; Shaktiman-3; Shaktiman-4 | Out of forty-four genotyped markers; six markers (UMC 1066, UMC 1133, UMC 1147, UMC 1241, UMC 1424 and UMC 1191) were highly polymorphic among parental lines (CML-142 X CML-150) and CML-186 and thus, may use for the identification of hybrid Shaktiman-1. Similarly, six markers (UMC 1064, Phio61, UMC 1072, UMC 1133, UMC 1858, UMC 1638) were highly polymorphic among parental lines CML-176 and CML-186 thus, may use for the hybrid purity test of maize hybrid Shaktiman-2. Hybrid purity test for Shaktiman 3 using SSR markers identified nine polymorphic markers (UMC 1013, UMC 1746, UMC 1035, UMC 2245, UMC 2372, UMC 1241, UMC 1858, UMC 1638, UMC 1191) between the parental lines CML-161 and CML–163. Six markers (UMC 1191, UMC 1638, UMC 1241, UMC 1133, UMC 2372, UMC 1071) were also identified among forty-four SSR markers as polymorphic among parental lines CML-161 and CML-169, thus, can be used for the identification of their hybrid Shaktiman 4. |

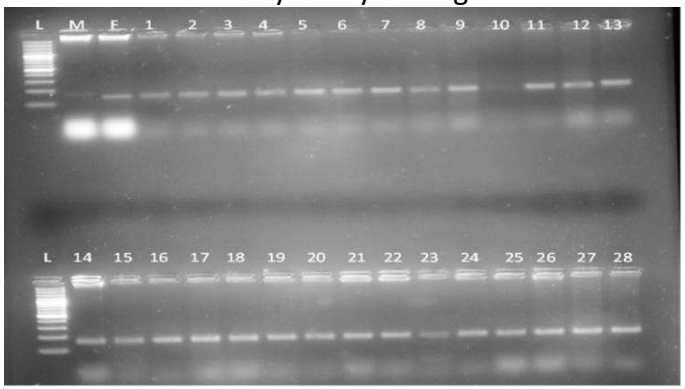
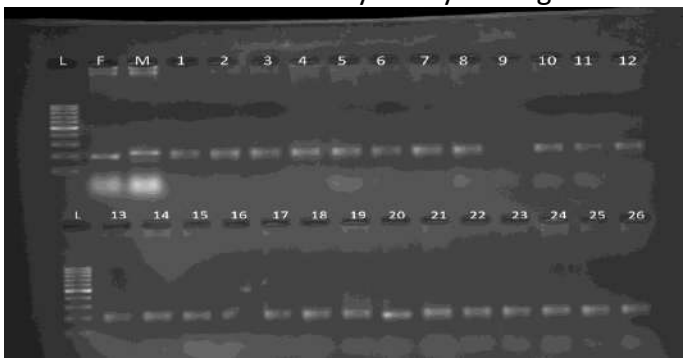


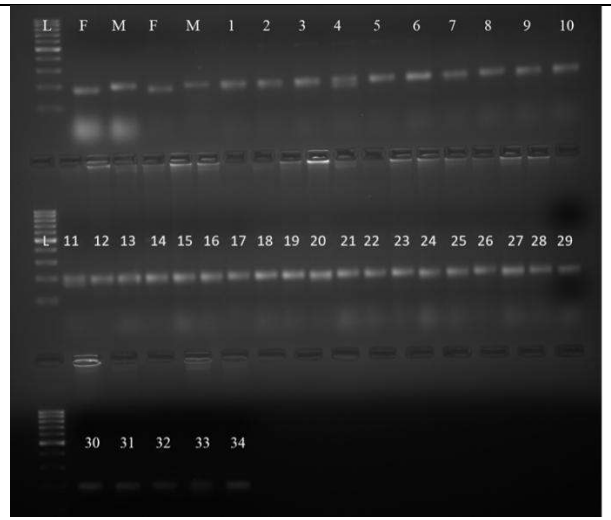

Marker genotyping for the parental line ((CML-142 X CML-150) and CML-186) and hybrid (Shaktiman1)




Marker genotyping for the parental line (CML-1 CML-186) and hybrid (Shaktiman 2)

| | | | | |
|---|---|---|---|---|
| | | |  Marker genotyping for the parental line (CML-161 and CML-163) and hybrid (Shaktiman 3) |  Marker genotyping for the parental line (CML-161 and CML-169) and hybrid (Shaktiman 4) | |
| 2 | UAS, Bengaluru | MAH 14-138 |  The primers Bnlg 1716 for MAH-14-138 hybrid can be used for the parental and hybrid purity testing | |
| **2 & 3 To validate the identified markers for establishing hybridity in different hybrids of various field crops & assess the efficiency of molecular markers in comparison with GOT** | | | | |
| **Maize: ICAR-NISST, Mau; AAU, Jorhat and RPCAU, Pusa** | | | | |
| 1 | ICAR-NISST, Mau | PMH 13<br>PMH14<br>MAH 14-5 | **1.** PMH 13 (Hybrid), LM27 (Female) and LM17 (Male) | |

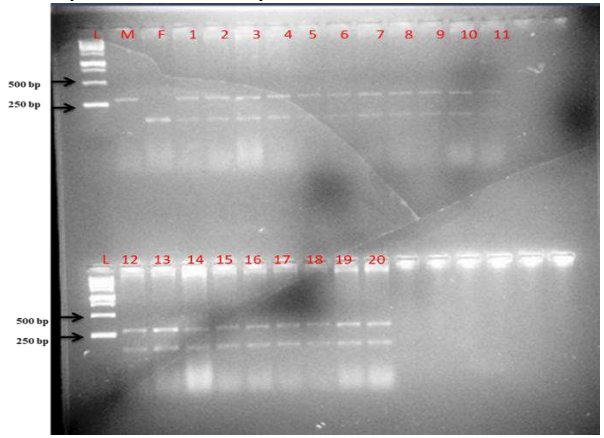
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| | | | **Result:** In this study, the SSR marker bnlg 1520 was found polymorphic among the parents. However, due to a small difference between male and female parent amplicons, the marker cannot be used for hybridity testing.<br><br><br>SSR Marker bnlg 1520 to test genetic purity using male, female and hybrid (PMH13)<br>**2.** PMH 14 (Hybrid)<br>Among the three markers provided, all markers showed polymorphism between male and female parents. However, the difference between male and female parent amplicons band was not significantly different lead to difficulty in identification of hybrids. Therefore, these markers can not be recommended for hybridity testing.<br><br><br>SSR Marker bnlg 1520 to test genetic purity using male, female and hybrid (PMH14) |




SSR Marker phi53 to test genetic purity using male, female and hybrid (PMH14)

**3.** Hybrid MAH 14-5

Marker bnlg 1185 has been found to be polymorphic and can differentiate between male and female parents. The hybrids showed both bands.




SSR Marker bnlg 1185 to test genetic purity using male, female and hybrid (MAH 14-5) M: Male, F: Female, L: 1 kb ladder, 1-20: Putative hybrids.

**Inference on GOT:**

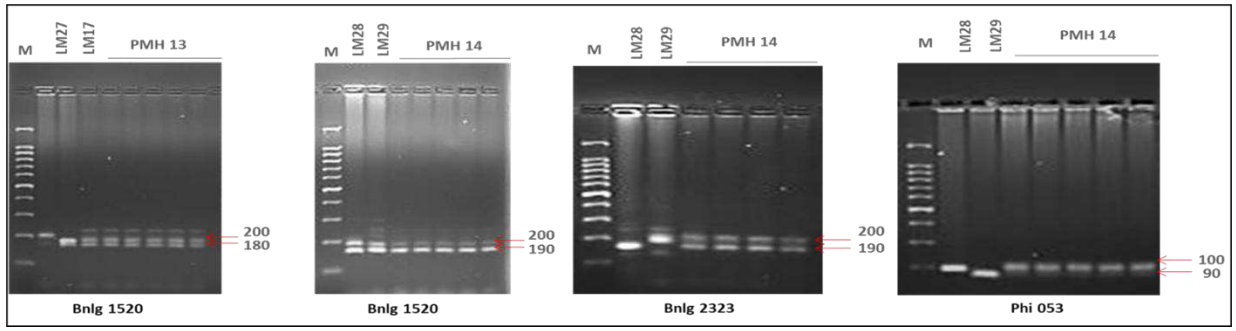
PMH 13: Due to poor germination, GOT could not be done. Given that SSR markers cannot properly differentiate between males and females, genetic purity cannot be calculated.

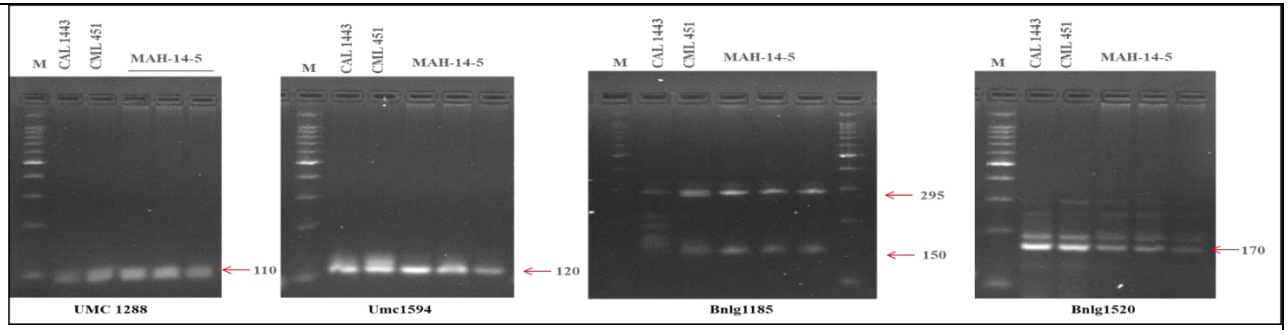
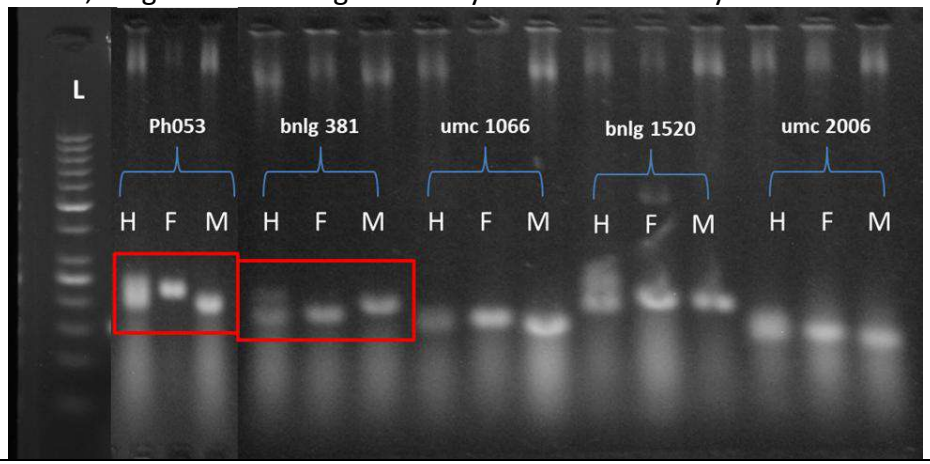
PMH 14: GOT 96.9%, Given that SSR markers cannot differentiate between male and female properly, hence, genetic purity cannot be calculated.

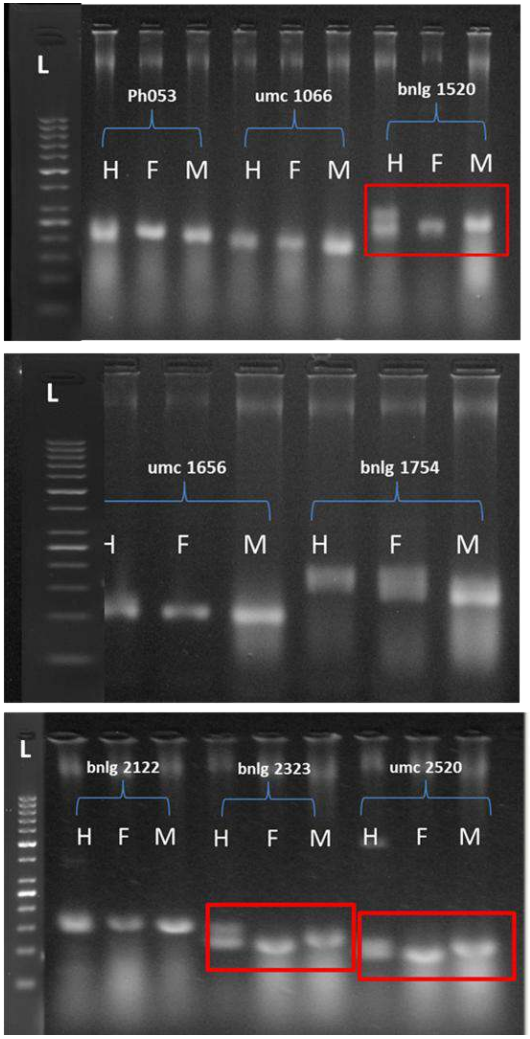
MAH14-5: GOT 94%, Genetic purity by marker is 97.3%.

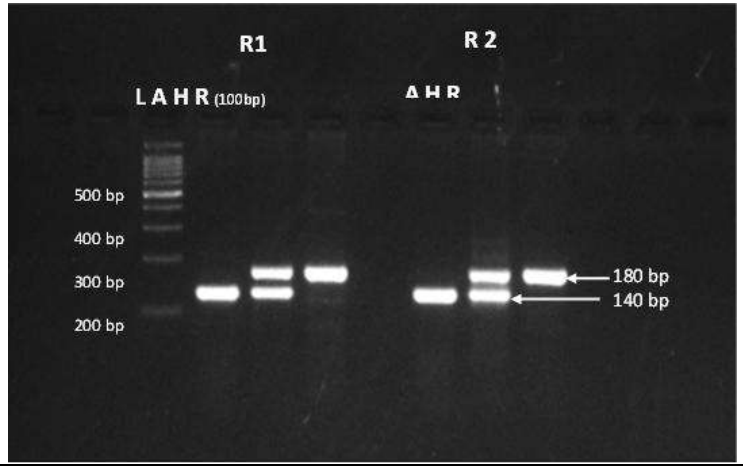
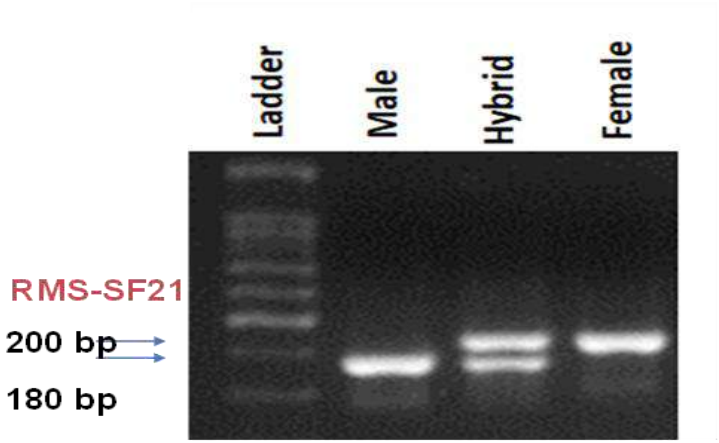
2 | AAU, Jorhat | PMH 13; PMH 14; MAH-14-5

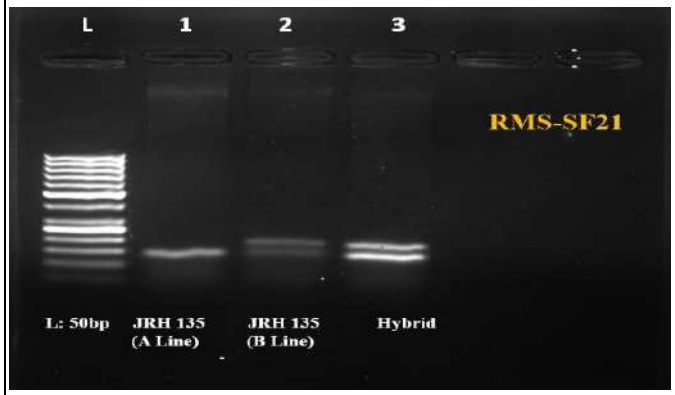
| S. No. | Maize Hybrid | Primer | Band Size (bp) | | | Results |
|---|---|---|---|---|---|---|
| | | | Female | Male | Hybrid | |
| 1 | PMH-13 | Bnlg 1520 | 200 | 180 | 200/180 | Validated |
| 2 | PMH-14 | Bnlg 1520 | 200 | 190 | 200/190 | Validated |
| | | Bnlg 2323 | 200 | 190 | 200/190 | Validated |
| | | Phi 053 | 100 | 90 | 100/90 | Validated |
| 3 | MAH-14-5 | Umc1288 | 100 | 100 | - | - |
| | | Umc1594 | 120 | 120 | - | - |
| | | Bnlg1185 | 295 | 150 | 295/150 | Validated |
| | | Bnlg1520 | 170 | 170 | - | - |



| | | | |
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| | | |  |
| 3 | RPCAU, Pusa | PMH 13<br>PMH 14 | In this study, all five SSR markers; umc 1066, umc 2006, bnlg 381, phi053 and bnlg 1520 were found to be polymorphic among the parents; LM 27 and LM 17. However, band resolution for polymorphic band between parent and hybrid for the SSR markers; phio53 and bnlg 381 were more. Thus, SSR markers phi053 and bnlg381 may be recommended for the PMH 13 hybrid detection.<br>Similarly, among eight SSR markers; umc 2520, umc 1066, umc 1656, bnlg 2323, bnlg 2122, bnlg 1754, bnlg 1520 and phi053. Out of which umc 2520, bnlg 2323 and bnlg 1520 were showing a clear distinguished polymorphism among parents and their contribution in hybrids. Thus, SSR markers; umc 2520, bnlg 2323 and bnlg 1520 may be used for the hybrid detection.<br> |

| | | | |
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| | | | *Study of Maize hybrid PMH-13 (H) and their parents LM 27 (F) and LM 17 (M) using eight different SSR markers*<br><br>*Study of Maize hybrid PMH-14 (H) and their parents LM 28 (F) and LM 29 (M) using eight different SSR markers.* |

| | | | |
|---|---|---|---|
| **Paddy: TNAU, Coimbatore; UAS, Bengaluru; and SKUAST,Srinagar; RPCAU, Pusa** | | | |
| 1 | **TNAU, Coimbatore** | JRH 135 | SSR marker RMS-SF21 showed polymorphism for rice hybrid JRH 135, parental lines A and R.<br> |
| 2 | **UAS, Bengaluru** | JRH 135 | The primers RMS-SF 21 for rice hybrid JRH 135 can be used for the parental and hybrid purity testing and hence it is validated.<br> |

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| 3 | **SKUAST,Srinagar** | JRH135 | The molecular marker RMS-SF21, already established, exhibited polymorphism between the hybrids and parental lines.<br>A total of 200 hybrid plants were analyzed, of which 5 were identified as off-types (lacking polymorphism).<br>Based on molecular marker data, the genetic purity of the hybrid seed was determined to be 97.50%.<br><br> |

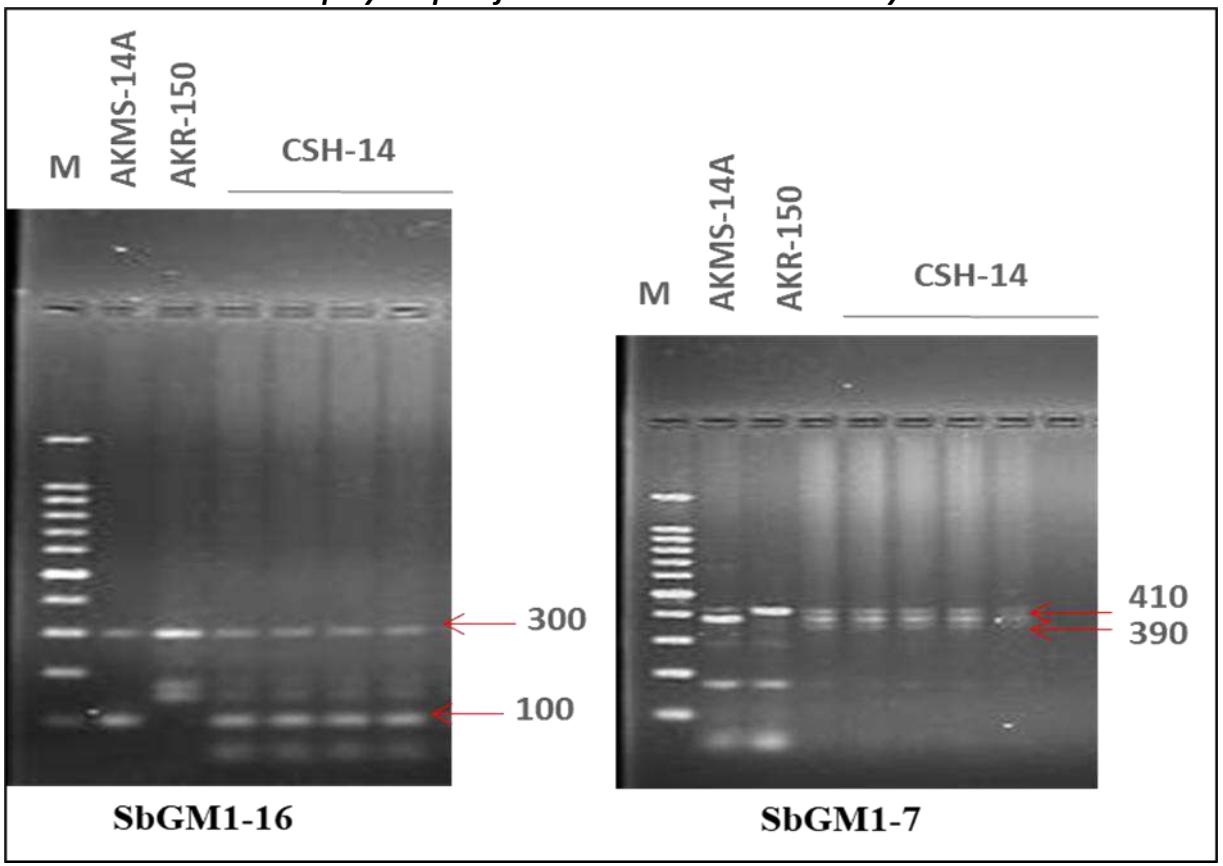
**Sorghum: AAU, Jorhat; PAJANCOA & RI, Karaikal; MPKV, Rahuri and VNMKV, Parbhani**

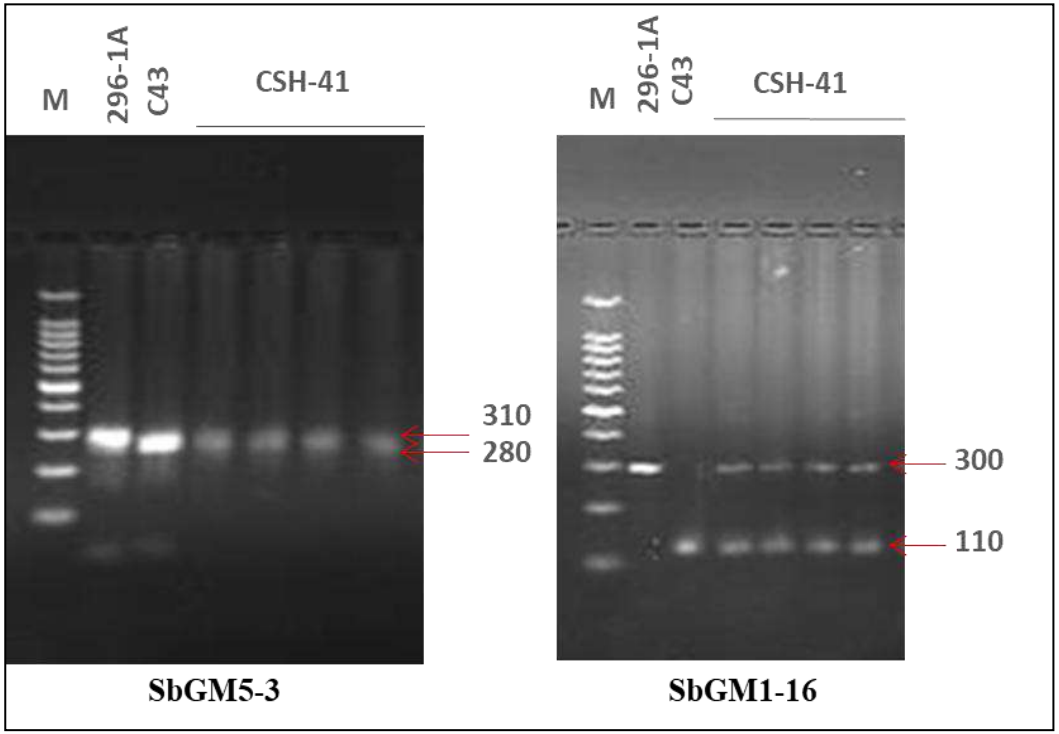
1 **AAU, Jorhat** — CSH-14, CSH-41

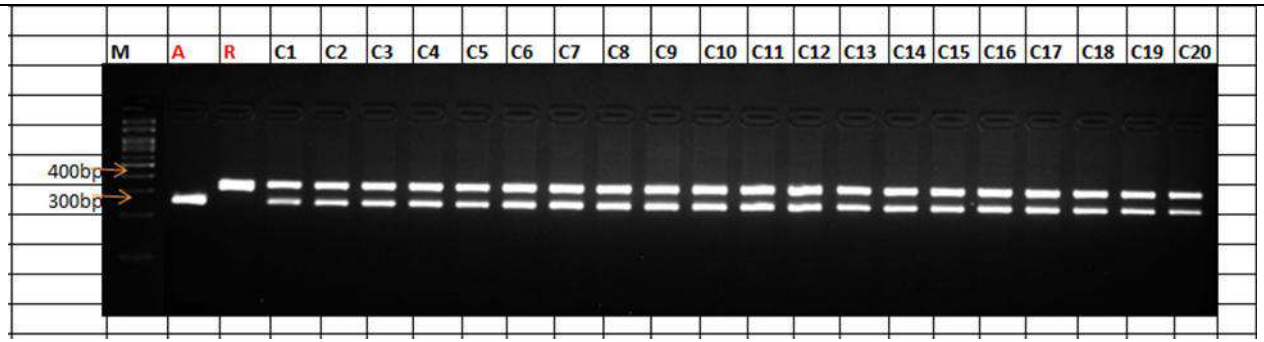
| Sorghum Hybrid | Primer | Band Size (bp) | | | Results |
|---|---|---|---|---|---|
| | | Female | Male | Hybrid | |
| CSH-14 | SbGM1-16 | 300 | 100 | **300/100** | **Polymorphic** |
| | SbGM5-6 | 370 | 370 | - | Monomorphic |
| | SbGM1-7 | 390 | 410 | **390/410** | **Polymorphic** |
| CSH-41 | SbGM5-3 | 300 | 280 | **300/280** | **Polymorphic** |
| | SbGM1-16 | 300 | 110 | **300/110** | **Polymorphic** |
| | SbGM5-6 | 500 | 500 | - | Monomorphic |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | SbGM1-7 | 400 | 400 | - | Monomorphic |

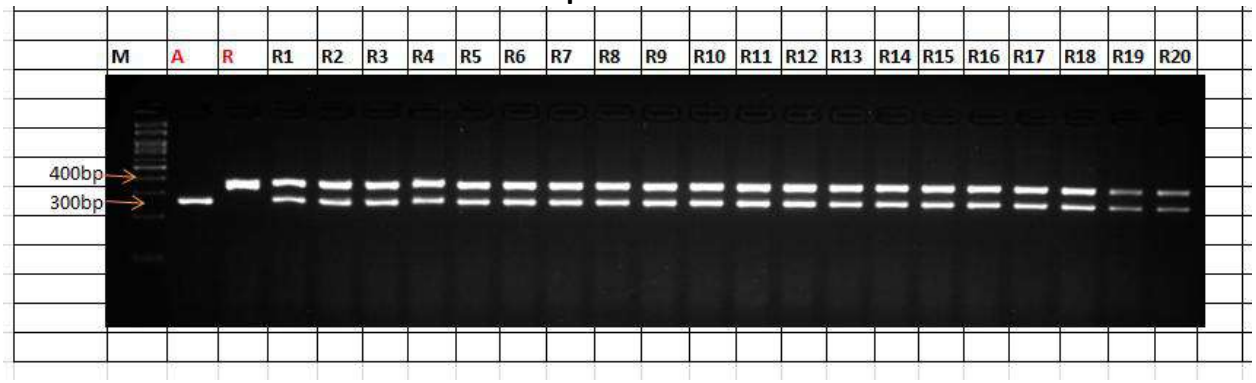
***Primer SbGM1-16 was polymorphic for both CSH-14 and CSH-41 hybrids**



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| | | | <br>In sorghum a total of 7 SSR markers were screened. Out of these for hybrid CSH 14, SSR marker SbGM1-16 SSR and SbGM1-7 are found suitable for screening hybridity. For sorghum hybrid CHS 41, two SSR markers SbGM5-3 and SbGM1-16 are found suitable for testing hybridity for this hybrid. |
| 2 | **PAJANCOA & RI, Karaikal** | CSH-14<br>CSH-41 | **Hybrid purity testing using molecular markers in public sector hybrids of field crops (Hybrid Sorghum CSH 14, along with parents)** |

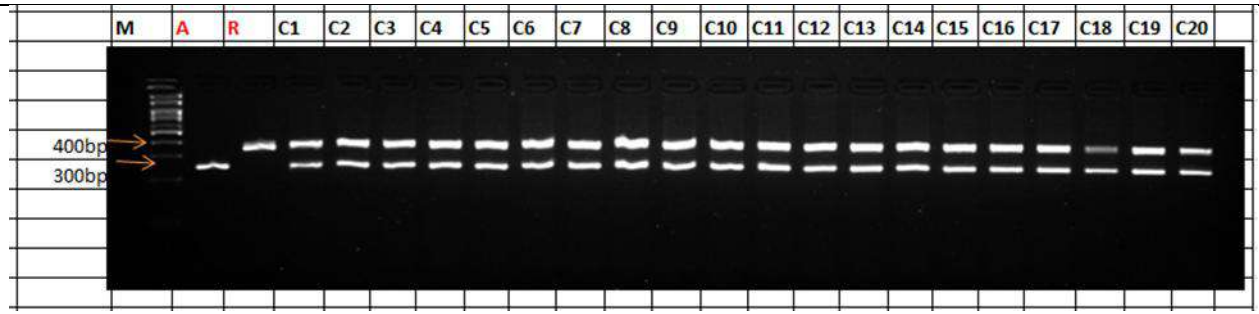



**Column-wise DNA Amplification of SbGM2-10 Marker**

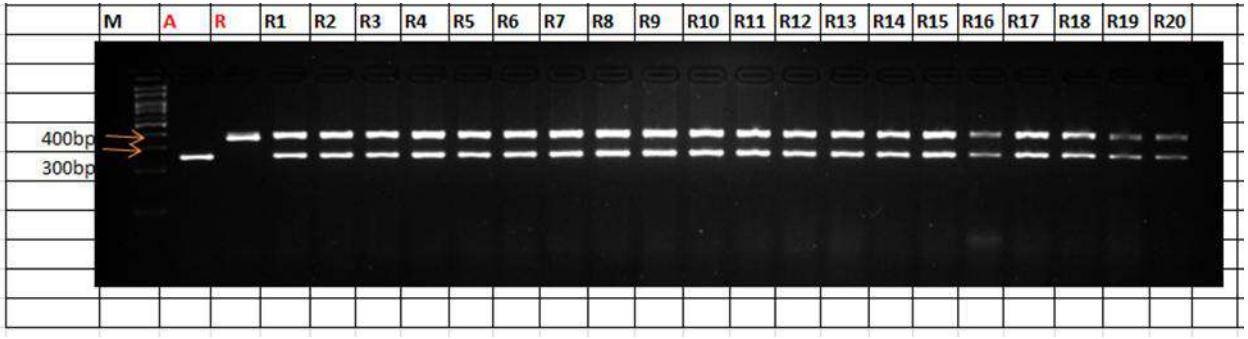



**Row-wise DNA Amplification of SbGM2-10 Marker**

**Hybrid purity testing using molecular markers in public sector hybrids of field crops (Hybrid Sorghum CSH 41, along with parents)**




**Column-wise DNA Amplification of SbGM2-10 Marker**




**Row-wise DNA Amplification of SbGM2-10 Marker**

For hybrid CSH-14, seven highly polymorphic primers (SbGM1-7, SbGM1-16, SbGM2-10, SbGM3-2, SbGM3-7, SbGM4-9 and SbGM8-1) may be used as informative SSR markers for testing hybrid purity.

For hybrid CSH-41, SbGM2-10, SbGM3-7, SbGM4-2, SbGM4-9, SbGM5-6, SbGM5-16, SbGM7-1, SbGM8-1, SbGM9-6, SbGM10-6 and Sb6-57 may be used as informative SSR markers for testing hybrid purity.

The primer SbGM2-10 may be used as an informative SSR marker for testing hybrid purity in both hybrids.

The validation using SSR markers also revealed no off-types, confirming 100% purity and demonstrating the marker's efficiency in hybrid purity testing.

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| | | | |
| 3 | MPKV, Rahuri | | **Seed not received** |
| 4 | VNMKV, Parbhani | | |

**Experiment 3: Physiological studies and development of priming technologies for enhancing planting value of seed in field crops under optimal and sub-optimal conditions**

| S. No | Centre | Varieties | Treatments | Remarks | Conclusion |
|---|---|---|---|---|---|
| **Validation of standardized priming technologies for low-temperature stress (LTS) / Organic condition** | | | | | |
| **Barley: ICAR-NISST, Mau; JNKVV, Jabalpur; PAU, Ludhiana, and RPCAU, Pusa** | | | | | |
| 1 | ICAR-NISST, Mau | DWBR101 and DWBR 123 | V1: Variety DWBR101<br>V2: Variety DWBR 123<br>T1: Thermopriming for 6h at 35˚C<br>T2: Hydropriming for 6h using 1:1 ratio<br>T0: Aged seed without treatment | Among the treatments, V1T1 recorded the highest first count (88.50%) and germination percentage (97.25%), which was statistically at par with V2T1 (86.00% and 96.25%, respectively). The lowest values were observed in V2T0 (61.50% first count and 77.00% germination), followed closely by V1T0. The increase in germination with treatments V1T1 and V2T1 was significant compared with the control treatments (V1T0 and V2T0), indicating improved seed performance. | Thermopriming for 6 h at 35°C shows improved performance in the first count, germination, Vigour Index I and II, and field emergence, followed by Hydropriming for 6 h at a 1:1 ratio. The Variety DWBR101 showed a better response to these treatments than Variety DWBR 123. |

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| | | | T#: Fresh Seed without treatment | The highest emergence was recorded in V1T1 (77.50%), which was at par with V1T2 (76.50%) and V2T2 (75.50%). | |
| | | | |  Barley seeds treated with Thermopriming 6 h 35 °C | |
| 2 | JNKVV, Jabalpur | | T1. Pre-chilling for 7 days at 5°C;<br>T2. Thermopriming for 6 h at 35°C<br>T3. Hydropriming for 6 h using a 1:1 ratio<br>T4. Priming with 10 ppm Ethrel at 25°C for 4h | Numerically, T4 (Priming with 10 ppm Ethrel at 25°C for 4h) recorded the highest seed set (93.35%) and the lowest empty seeds per panicle (1.81), indicating better seed filling. T1 recorded the highest 1000-seed weight (52.03 g). Overall, T2 performed best for seed yield, while T4 showed better seed-setting efficiency. | Thermopriming for 6 h at 35°C recorded the highest seed yield per plant (25.68 g). |

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| | | | |  Field view of the experiment on validation of standardized priming technology in barley |

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| 3 | PAU, Ludhiana | DWRUB 52 | T1: Control<br>T2: Hydropriming for 2 hours using a 1:1 ratio<br>T3: Thermopriming for 6h at 35°C<br>T4: Priming with 10 ppm Ethrel at 25°C<br>T5: Pre-chilling for 7 days at 5°C | Biological, straw and seed yield were significantly influenced by date of sowing, with timely sowing recording the highest mean biological yield (11.57 kg/plot), straw yield (6.39 kg/plot) and seed yield (5.18 kg/plot). Late sowing caused a marked reduction in yield, especially seed yield (2.95 kg/plot). Among seed priming treatments, hydropriming recorded the highest biological yield (10.82 kg/plot) and seed yield (4.62 kg/plot), and was superior to control. The harvest index was significantly affected only by the date of sowing, with early and timely sowing yielding higher values than late sowing. The DOS × priming interaction was not significant for all yield parameters, indicating similar treatment responses across sowing dates. | Seed yield was found to be the highest in the timely sown crop, followed by the early and late sown crops.<br>Priming treatments significantly increased seed yield, with the greatest enhancement observed with Hydropriming, followed by thermopriming, which was statistically on par. |
| 3 | RPCAU, Pusa | RD-2907<br>RD-2849 | T1: Control<br>T2: Bavistin<br>T3: Thermo priming 6 hrs @35$^0$C<br>T4: Hydro priming 6 hrs @20$^0$C | Hydro priming recorded the highest number of seeds per panicle (52.3), which was significantly superior to control (46.4). Empty seeds per panicle did not vary significantly among treatments, although hydro priming recorded the lowest value (5.4). Thousand seed weight did not | Among seed treatments, hydro priming emerged as the most effective practice, consistently improving plant establishment, growth parameters, seed yield, and harvest index across both varieties. Thermo priming also showed beneficial effects but was |

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| | | | | show significant differences among treatments, though hydro priming (28.0 g) and thermo priming (27.6 g) recorded slightly higher values. Seed yield per plot was significantly enhanced by hydro priming (0.749 kg), followed by thermo priming (0.630 kg) and Bavistin treatment (0.591 kg), all being superior to control (0.468 kg). Harvest index was also significantly improved by hydro priming (25.7%), followed by thermo priming (24.4%), whereas the lowest value was observed in untreated control (19.8%). | comparatively less effective than hydro priming. |
| **Oats: OUAT, Bhubaneswar; CSKHPKV,Palampur; JNKVV, Jabalpur, and RPCAU Pusa** | | | | | |
| 1 | OUAT, Bhubaneswar | Kent | $T_1$: $GA_3$ @ 600 ppm<br>$T_2$: Halopriming with $CaCl_2$ @ 1.5% for 24 h<br>$T_3$: Thermo priming treatment of 40°C for 36 h<br>$T_4$: Hydropriming for 24 h at 20°C | Halopriming with $CaCl_2$ @ 1.5% for 24 h recorded the highest seed yield (19.84 kg/ha), harvest index (13.03%), SVI-I (2642.1) and SVI-II (6.503). Whereas priming with $GA_3$ at 200 ppm also performed well and was statistically on par with halopriming for yield and vigour traits. | Highest increase in germination and vigour indices was observed in $T_2$ (Halopriming with $CaCl_2$ 1.5%), followed by $T_5$ (priming with $GA_3$ 200 ppm). All the yield attributing parameters and seed yield were also highest in halopriming with $CaCl_2$ 1.5%. The seed yield in this treatment was 19.84 q/ha, followed by $T_1$ (19.46 q/ha). |

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| | | | $T_5$: Priming with 200 ppm gibberellic acid<br>$T_6$: Hydro priming followed by pre-chilling treatment for 7 days @ $4^0$C. | | |
| 2 | CSKHPKV, Palampur | Kent Palampur-1 | $T_1$ : $GA_3$ 600 ppm (1:1 ratio) for 6 hrs. at $20^0$C<br>$T_2$: $CaCl_2$ 1.5 % (1:1 ratio) for 24 hrs. at $20^0$C<br>$T_3$: Thermopriming at $40^0$C for 36 hrs.<br>$T_4$: Hydropriming (1:1 ratio) for 24 hrs. at $20^0$C<br>$T_5$: $GA_3$ 200 ppm (1:1 ratio) for 6 hrs. at $20^0$C<br>$T_6$: Hydropriming (1:1 ratio) for 6 | The seeds hydro-primed (1:1 ratio) for 24 hrs. at 20 $^0$C recorded the highest plot yield (1.34 kg), which was at par with treatment seed priming with $GA_3$ 200 ppm (1:1 ratio) for 6 h at $20^0$C (1.28 kg) and treatment, seed priming with $GA_3$ 600 ppm (1:1 ratio) for 6 h at $20^0$C (1.28 kg). On the other hand, un-primed seeds recorded lowest plot yield (0.88 kg), irrespective of varieties. | Hydro-priming (1:1 ratio) for 24 h at $20^0$C or priming with $GA_3$ 200 ppm (1:1 ratio) for 6 hrs. at $20^0$C of seeds of Palampur-1 or Kent variety can produce significant positive effects on speed of emergence, total number of seeds per panicle, number of empty seeds per panicle per cent seed set, plot yield and harvest index. |

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| | | | hrs. at $20^0$C followed by pre-chilling for 7 days at $4^0$C<br>$T_7$: Control | | |
| 3 | JNKVV, Jabalpur | Kent | T1: $GA_3$ @ 600ppm<br>T2: Seed halo-priming with $CaCl_2$ @1.5%for 24 h<br>T3: Thermopriming at 40 °C for 36 h<br>T4: Hydropriming for 24 h at 20°C<br>T5: Priming with 200 ppm gibberellic acid<br>T6: Hydro priming followed by pre-chilling treatment for 7 days @ 40 $^0$C. | Among the different seed priming treatments, seed halo-priming with $CaCl_2$ @ 1.5% for 24 h recorded the highest values for all major yield-attributing traits, including panicle length (39.95 cm), 1000-seed weight (33.83 g), seed yield per plant (12.57 g), seed yield (4124.44 kg $ha^{-1}$), and harvest index (11.77%).<br>The next-best treatment for seed yield was thermo-priming at 40°C for 36 h, yielding 3432.89 kg $ha^{-1}$, followed by hydropriming. | Seed halo-priming with $CaCl_2$ @ 1.5% for 24 h was the best treatment for enhancing seed yield and yield-attributing traits. |
| 4 | RPCAU, Pusa | BR07; P31 | T1: Control I (Untreated) | Hydropriming for 24 h at 20°C recorded the highest number of seeds per panicle (38.9), seed yield (0.332 kg/plot), and harvest index | The results indicate that varietal differences were more pronounced in growth traits than yield attributes in oat. Variety P31 showed superiority in |

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| | | | T2: Control II (Bavistin Treated)<br>T3: Hydro priming 24 hrs @200C<br>T4: GA3 Priming @200 ppm | (15.7%). $GA_3$ priming @ 200 ppm recorded the same seed yield (0.332 kg/plot) and was statistically at par with hydropriming for seed yield and harvest index. Both hydropriming and $GA_3$ priming were superior to untreated and Bavistin-treated controls for seed yield. Overall, hydropriming 24 hrs at 20°C and $GA_3$ priming @ 200 ppm were the best treatments, with hydropriming showing a slight numerical advantage in seeds per panicle and harvest index. | tillering capacity, while BR07 exhibited slightly better plant height and yield. Among seed treatments, hydro priming emerged as the most effective, significantly improving plant establishment, tillering, seed yield, and harvest index. $GA_3$ priming mainly enhanced plant height and also contributed to yield improvement, though slightly less effectively than hydro priming. |
| 5 | AAU, Jorhat | Kent | T1: Dry seeding<br>T2: Hydropriming for 24 h at 20°C<br>T3: Priming with 200 ppm $GA_3$ | Seed treatment significantly improved final stand establishment, plant height, and green fodder yield compared with dry seeding. Among the treatments, $GA_3$ @ 200 ppm recorded the highest final stand establishment (40.50 plants/$m^2$), plant height (121.00 cm) and green fodder yield (143.50 g/plant), and was superior to soaking and dry seeding. $GA_3$ treatment also resulted in earlier flowering (60 days) and the highest biological yield per plot (279.7 q). | $GA_3$ treatment increased fodder yield by approximately:<br>• 15% compared to dry seeding<br>• 7% compared to seed soaking |

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| **Pearl millet: PDKV, Akola; JAU, Jamnagar and CCSHAU, Hisar** | | | | | |
| 1 | PDKV, Akola | Nitya Vikas Hybrid | T1: Control (Untreated)<br>T2: Hydropriming for 8h (1:1 ratio)<br>T3: Biopriming with *T. Viride* | Biopriming recorded the highest seed set (84.60%), 1000-seed weight (8.05 g), plot yield (55.29 kg/500 m²), germination (88.62%), vigour index-I (1568.21) and NMR (₹49,772).<br>Hydropriming also improved plot yield (51.55 kg/500 m²) and economic return over control, but was lower than biopriming. | Although statistical significance was not observed, biopriming treatment T. viride (CFU-2 X $10^9$ per g) @ 10 g/kg seed, mixing 10 g in 50 ml of water and applied on 1 kg of seed uniformly, consistently recorded higher values for most growth, yield and vigour parameters compared to control and hydropriming. |

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| | | | |  Biopriming treatment for Validation of Standardized priming technologies in pearl millet. | |
| 2 | JAU, Jamnagar | GHB 732; GHB 905 | T1: Hydropriming for 8h (1:1 ratio)<br>T2: Hormopriming $GA_3$ @ 250ppm<br>T3: Control (Untreated) | Hormopriming with $GA_3$ @ 250 ppm recorded the best overall performance. It produced the highest total number of seeds per panicle (1276.88), seed set percentage (85.57%), 1000-seed weight (9.91 g), plot yield (2.79 kg), and harvest index (28.31%). The plot yield under T2 was significantly higher than the untreated control, indicating that $GA_3$ hormopriming improved seed yield performance. Hydropriming for 8 h at 1:1 ratio recorded a plot yield of 2.67 kg, | Hormo-priming with $GA_3$ at 250 ppm was found to be the best priming treatment for increasing yield and its attributes, with good seed quality and a higher cost-benefit ratio (1.97) in pearl millet. |

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| | | | | which was numerically lower than $GA_3$ hormopriming but higher than the untreated control. T3: Control, recorded the lowest total number of seeds per panicle (1064.63) and plot yield (2.34 kg), indicating that the absence of priming resulted in comparatively poorer seed yield attributes. | |
| 3 | CCSHAU, Hisar | HHB 299 | T1=Control (Untreated), T2= (Recommended PoP) treated with Biomix (100 ml/acre), T3= KNO3 (1.0% for 12h), T4= Hydropriming for 8h (1:1 ratio), T5= Trichoderma (15 ml/kg seeds), T6= NaCl (0.5% NaCl for 12h) | The highest plot yield and seed yield were recorded in $KNO_3$ @ 1.0% for 12 h (3.428 kg/8 $m^2$ and 42.85 q/ha), followed by NaCl @ 0.5% for 12 h (3.367 kg/8 $m^2$ and 42.08 q/ha) and Trichoderma @ 15 ml/kg seeds (3.308 kg/8 $m^2$ and 41.35 q/ha). However, the differences in both plot yield and seed yield were not statistically significant, suggesting that the treatments did not produce a reliable yield advantage over the control. | Among the treatments, $KNO_3$ priming at 1.0% for 12 h is numerically promising but not statistically superior for improving seed yield. |
| | | | | | |
| **Sorghum: TNAU,Coimbatore; VNMKV, Parbhan; SHUATS, Prayagraj and OUAT, Bhubaneswar;** | | | | | |
| 1 | TNAU, Coimbatore | CO 32 | T1: Control (Untreated) | Among the treatments, $KH_2PO_4$ 2% for 16 h recorded the highest mean | Moisture stress at vegetative and flowering stages reduced growth, yield |

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| | | | T2 : $KH_2PO_4$ 2 % for 16 h @ 1:1 ratio (w/v -Seed : Solution)<br>T3 : KCl 1 % for 30 h @ 1:1 ratio (w/v -Seed : Solution)<br>T4:Hydropriming for 30 h @ 1:1 ratio (w/v -Seed : Solution)<br>$M_0$ : Normal condition<br>$M_1$ : Withholding one irrigation at vegetative stage (40 DAS)<br>$M_2$ : Withholding one irrigation at flowering stage (70 DAS) | yield of 3022 kg/ha, followed by KCl 1% for 30 h (2876 kg/ha), Hydropriming for 30 h (2763 kg/ha), and Control (2565 kg/ha).<br><br>$KH_2PO_4$ 2% seed priming for 16 h was the best treatment, recording the highest mean yield (3022 kg/ha) and B:C ratio (3.14). Among moisture regimes, normal irrigation conditions recorded the highest yield, while withholding irrigation at the flowering stage caused greater yield reduction than withholding irrigation at the vegetative stage. | attributes and productivity of sorghum, with the maximum reduction observed when irrigation was withheld at the flowering stage. However, seed priming, particularly with $KH_2PO_4$ 2% for 16 hours, significantly improved emergence, plant growth, seed set and yield even under moisture stress conditions, demonstrating its effectiveness in mitigating drought stress in sorghum CO 32. |

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| 2 | VNMKV, Parbhani | V1- Parbhani Supermoti<br>V2- Parbhani Jyoti<br><br>(L1 : Fresh and L2: Old) | $T_1$: Hydro priming (8 h)<br>$T_2$: Hydro priming (12 h)<br>$T_3$: Hydro priming (20 h)<br>$T_4$:Hormopriming $KNO_3$ 1% (12 h)<br>$T_5$:Hormopriming GA-200 ppm (12 h)<br>$T_6$:Hormopriming GA-250 ppm (12 h)<br>$T_7$ : Control | Hydropriming for 20 h in fresh seed lot of Parbhani Jyoti recorded the highest germination percentage. For field emergence, T3V1L1, T1V2L1 and T2V2L2 recorded the highest values. T4V1L1 — $KNO_3$ 1% priming for 12 h in fresh seed lot of Parbhani Supermoti showed the highest numerical vigour index-I, while T1V2L1 — Hydropriming for 8 h in fresh seed lot of Parbhani Jyoti recorded the highest vigour index-II. | Overall, hydropriming treatments were more consistent in improving germination and field emergence, especially in fresh seed lots. Among the varieties, Parbhani Jyoti fresh seed lot responded well to hydropriming, particularly 20 h for germination and 8 h for vigour index-II. |

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| 3 | SHUATS, Prayagraj | | $T_1$: Hydropriming (for 30 hours); $T_2$: Halopriming (1% KCl for 30 hours); $T_3$: Halopriming (KH 2 PO 4 @ 2% for 16 h) $T_4$: Control | The highest germination was recorded in $KH_2PO_4$ @ 2% for 16 h with 92%, followed by KCl @ 1% for 30 h with 89%, $T_1$: Hydropriming for 30 h with 84%, and control with 70%. The highest field emergence was recorded in $T_3$: $KH_2PO_4$ @ 2% for 16 h with 87%, followed by $T_2$: KCl @ 1% for 30 h with 84%, $T_1$: Hydropriming for 30 h with 80%, and control with 65%. | In sorghum, $KH_2PO_4$ @ 2% for 16 h may be considered the most effective priming treatment for improving seed germination, seedling vigour and field emergence. |
| 4 | OUAT Bhubaneswar | In progress | | | |
| **Wheat: CCS HAU, Hisar; CSKHPKV, Palampur; PAU, Ludhiana; RPCAU Pusa; ICAR-NISST, Mau; SKNAU, Jobner; GBPUAT, Pantnagar and SHUATS, Prayagraj** | | | | | |
| 1 | CCS HAU, Hisar | WH-1270 and WH-1105 | Hydropriming: (2 h to 16 h) and amount of water (W/V Half to double the amount) | Controlled hydration significantly improved germination in both fresh and one-year-old seed lots (WH 1270). The fresh seed lot recorded higher mean germination of 92.46% compared with the one-year-old seed lot at 89.47%, indicating a clear decline in germination due to seed ageing. Among the water volumes, half volume of water per weight of seed (HV) was the best, recording the highest mean germination in both seed lots. In the fresh seed lot, HV recorded 93.33%, followed by EV | Priming seeds for 10–12 h using half volume of water per weight of seed may be considered the most suitable treatment. |

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| | | | | 92.38% and DV 91.67%. In the one-year-old seed lot, HV recorded 89.76%, while EV and DV both recorded 89.33%. Among soaking durations, germination increased up to 10–12 h and declined at 16 h.<br>In WH-1105, the best treatment combination was 12 h soaking with half volume of water (HV), which recorded 97.00% germination in the fresh seed lot and 95.00% germination in the one-year-old seed lot. | |
| 2 | CSKHPKV, Palampur | HPW 349 and HPW 368 | Treatments: Untreated control; Control(vitavax treatment); Pre-chilling; Thermopriming; Hydropriming; Osmopriming; Hormoprimingand Biopriming | Prechilling at 5°C recorded the highest first count (97.33%), germination (97.33%), SVI-I (2199.63), and SVI-II (1453.10), which were statistically on par with prechilling at 10°C.<br>Thermopriming, particularly at 30°C for 24–36 hours and at 35°C for 48 hours, substantially recorded higher first count, germination, seed vigour and field emergence.<br>Hydropriming—particularly 4 to 6 hours at a 1:1 ratio and 4 to12 hours at a 1:½ ratio—recorded higher first count, germination.<br>Osmopriming for 6 hours, particularly between −0.05 to −0.73 | |

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| | | | | MPa, showed better numerical performance in germination and vigour indices. | |
| 3 | RPCAU, Pusa | DBW 187; HD 2967 | Control I (Untreated); Control II (Bavistin); Hydropriming (12 h); Thermopriming 6 hrs, $30^0$C; $GA_3$ @200 ppm; Ethrel @ 10 ppm; $KNO_3$ 1 % | Among the seed treatments, $KNO_3$ 1% was superior for increasing seeds per panicle, recording 38.9 seeds/panicle in DBW 187 and 43.3 seeds/panicle in HD 2967. However, for seed yield per plot, thermopriming for 6 h at 30°C recorded the highest yield in both varieties, with 0.749 kg/plot in DBW 187 and 0.739 kg/plot in HD 2967. Ethrel @ 10 ppm also performed well, particularly for reducing empty seeds and improving seed weight. | Overall, HD 2967 showed better response for seeds per panicle, while DBW 187 recorded slightly higher maximum seed yield per plot under thermopriming. Since most yield parameters except seeds per panicle were statistically non-significant, $KNO_3$ 1% may be considered promising for seed number, whereas thermopriming showed the best numerical advantage for seed yield. |
| 4 | SKNAU, Jobner | Raj 1482; Raj 4037 | $T_1$: Control<br>$T_2$: Hydropriming for 6 (1:1/2 ratio)<br>$T_3$: Hydropriming for 6 (1:1 ratio)<br>$T_4$: Hydropriming for 6 (1:1.5 ratio) | Among the treatments, hormopriming with $GA_3$ @ 200 ppm recorded the highest mean germination (94.75%), followed by hydropriming for 6 h in 1:1 ratio (94.00%) and hormopriming with $GA_3$ @ 250 ppm (93.44%). The lowest germination was recorded in control (89.81%). | Seed germination was significantly improved by priming treatments. $GA_3$ @ 200 ppm was the best treatment, recording the highest pooled germination of 94.75%, which was 4.94 percentage higher than control (89.81%). Among hydropriming treatments, hydropriming for 6 h in 1:1 ratio was the best, recording 94.00% germination, and may be considered a practical low-cost alternative to $GA_3$ priming. |

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| | | | $T_5$: Hormo priming (GA,150 ppm) $T_6$: Hormo priming (GA,200 ppm) $T_7$: Hormo priming (GA, 250 ppm) | | |
| 5 | GBPUAT, Pantnagar | UP 2944 | T1:Control;T2:Hydropriming ,duration 12 h (seed :water ratio::1:1) T3: Thermopriming (6 h for $30^0$C); T4:Hormone priming ($GA_3$ @ 200ppm) T5: Osmopriming ($KNO_3$ @1%) | Among the priming treatments, $KNO_3$ @ 1% recorded the highest seedling length (26.1 cm), seedling dry weight (22.0 g), SVI-I (2545), SVI-II (2146) and speed of emergence (17.5 seedlings/day). Although final germination was non-significant, priming improved early germination and seedling vigour. Seed Yield data is awaited as still crop is in the field. | |
| 6 | PAU, Ludhiana | In Progress | | | |
| 7 | SHUATS, Prayagraj | In Progress | | | |
| **Demonstration of validated priming technologies to be repeated in a minimum of 500sqm for validated treatment along with control/s in the specified stress conditions** | | | | | |
| **Maize (LT stress) SKUAST, Srinagar** | | | | | |

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| 1 | SKUAST, Srinagar | Shalimar Maize Composite-7; Shalimar Maize Composite-8 | •Hydropriming (30h @ 25 °C) followed by dry dressing with Trichoderma harzianum (@15 g/kg seed)<br>• Seed coating on hydro-primed seeds with cold adaptive PGPB<br>• Seed priming with $GA_3$ followed by DAB + Biophos | For the maize variety Shalimar Maize Composite-7 (V1), a 4 % increase in final plant stand was observed in the treated plots compared to the control. The treated plots recorded a final plant stand of 96.30% whereas the control plot recorded a final plant stand of 92.60%.<br>For the maize variety Shalimar Maize Composite-7 (V1), 8.8% increase in grain yield per plant was observed in the treated plants compared to the control. The treated plots recorded grain yield per plant of 98 g, whereas the control plots recorded grain yield per plant of 90 g.<br>For the maize variety Shalimar Maize Composite-8 (V2), 8.6% increase in grain yield per plant was observed in the treated plants compared to the control. The treated plots recorded grain yield per plant of 91.6 g, whereas the control plots recorded grain yield per plant of 84.3 g. | For the maize variety Shalimar Maize Composite-7 (V1), 9.5% increase in grain yield per plot (500 Sq. m) was observed in the treated plots compared to the control. The treated plots recorded grain yield per plant of 325.75 kg, whereas the control plots recorded grain yield per plot of 297.25 kg.<br><br>For the maize variety Shalimar Maize Composite-8 (V2), 10% increase in grain yield per plot (500 Sq. m) was observed in the treated plots compared to the control. The treated plots recorded grain yield per plant of 290.25 kg, whereas the control plots recorded grain yield per plot of 263 kg. |
| **Paddy (LT Stress): SKUAST, Srinagar** | | | | | |

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| 1 | SKUAST, Srinagar | Shalimar Rice-2; Shalimar Rice-4 | Seed coating with cold adaptive PGPB | For the rice variety Shalimar Rice 2(V1), 10.7 % increase in grain yield per plot (500 Sq.m.) was observed in the treated plots compared to the control. The treated plots recorded grain yield per plot of 392 kg, whereas the control plots recorded grain yield per plot of 354kg.<br><br>Similarly, for the rice variety Shalimar Rice 4(V2), 10 % increase in grain yield per plot (500 Sq.m.) was observed in the treated plots compared to the control. The treated plots recorded grain yield per plot of 438 kg, whereas the control plots recorded grain yield per plot of 398kg. | |
| **Sunflower: UAS, Raichur; PDKV, Akola and UAS, Bangalore** | | | | | |
| 1 | UAS, Raichur | RSFH-700 | Hydropriming sunflower seeds for 24 hours at 20 $^{o}$C | Seed hydropriming for 24 hours at 20°C recorded 95% germination, 93% first count, SVI-I of 2571, SVI-II of 38, and the fastest radicle emergence at 31.5 hours.<br><br>Seed hydropriming for 24 hours at 20°C was the best treatment, recording the highest seed yield and economic return. It improved seed yield per plot from 55 kg in | Seed hydropriming for 24 hours at 20°C is a simple and economically beneficial seed enhancement practice for improving seed yield in sunflower. |

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| | | | | untreated control and 59 kg in recommended PoP control to 80 kg, along with the highest B:C ratio of 2.33. This indicates that hydropriming is a simple and economically beneficial seed enhancement practice for improving seed yield. | |
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| 2 | PDKV, Akola | PDKVSH-964 | Control (Untreated); Hydropriming seeds for 24 hrs at $20^0$C (1:1 ratio) and Biopriming with *T. Viride* | Hydropriming recorded the highest plot yield of 71.95 kg/500 m², followed by biopriming at 67.66 kg/500 m² and the control at 58.81 kg/500 m². For harvest index, hydropriming recorded the highest value | Among the treatments, Hydropriming seeds for 24 hrs at 20 $^0$C (1:1 ratio) recorded the best performance in terms of speed of emergence, plant height, seed set percentage, seed yield and economic returns, followed by biopriming. |

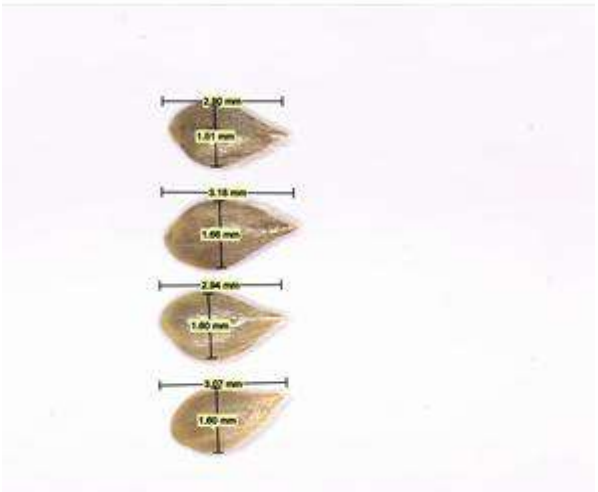
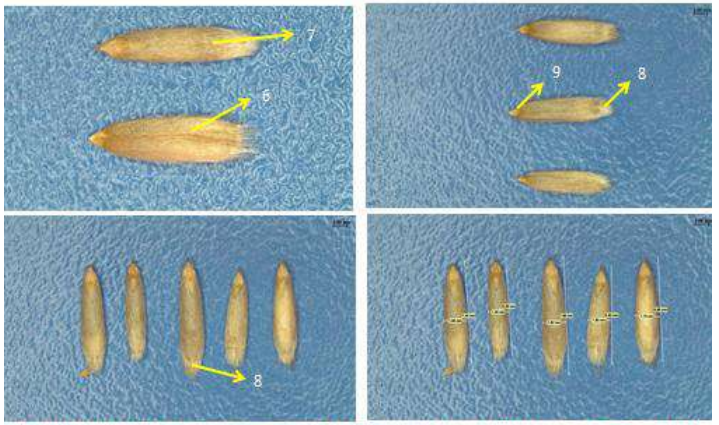
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| | | | | (36.31%), followed by biopriming (36.16%) and control (35.80%). Hydropriming gave the highest net monetary return (NMR ₹115,120), where control had ₹ 94,080. | |
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| 3 | UAS, Bangalore | KBSH -41 | $T_1$ - Control (POP), $T_2$ - Hydropriming for 16hr of soaking at $25^0$C. | Seed priming with hydropriming for 16 hours at $25^0$C has recorded the maximum germination (95%), seedling vigour index I (2850), seedling vigour index II (1906), field emergence (78.50%), compared to untreated seeds. Final plant stand % was higher in primed (79%) and lower in control (70.50%). 1000 seed weight was high in treated compared to control. Seed yield per plant was higher in T2 (26.66g), and lower in T1 (23.18g). Seed yield per plot was higher in T2 (1029.68g) and | Hydropriming treatment (T2: *Hydropriming* for 16hr of soaking at $25^0$C) soaking seeds for 16hr has enhanced the planting value of seed under optimal and sub-optimal conditions |

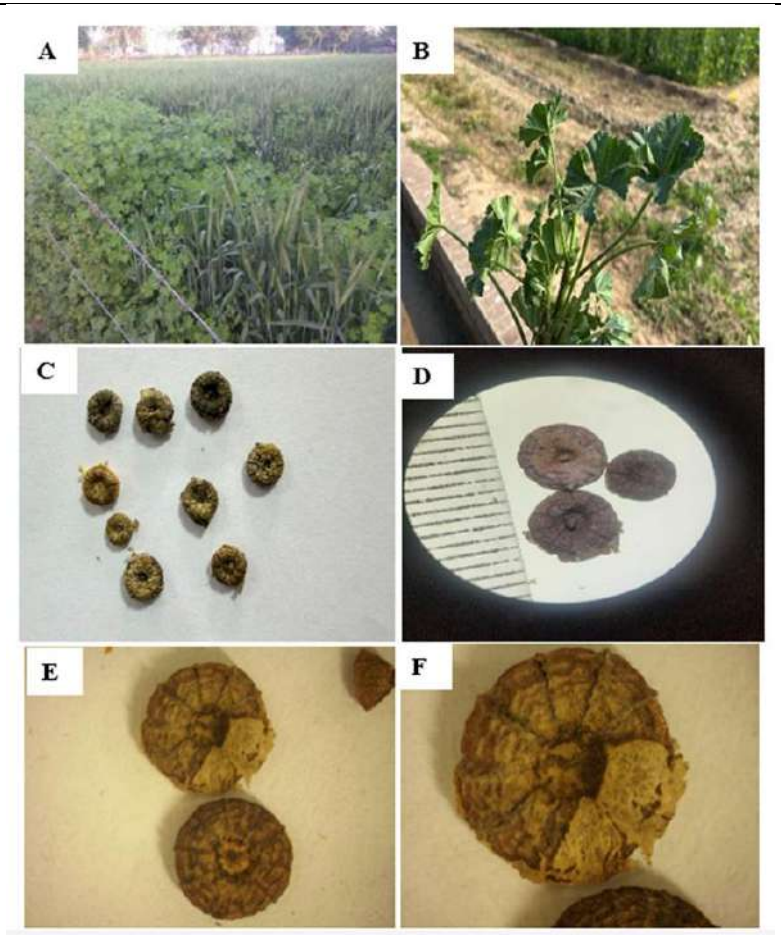
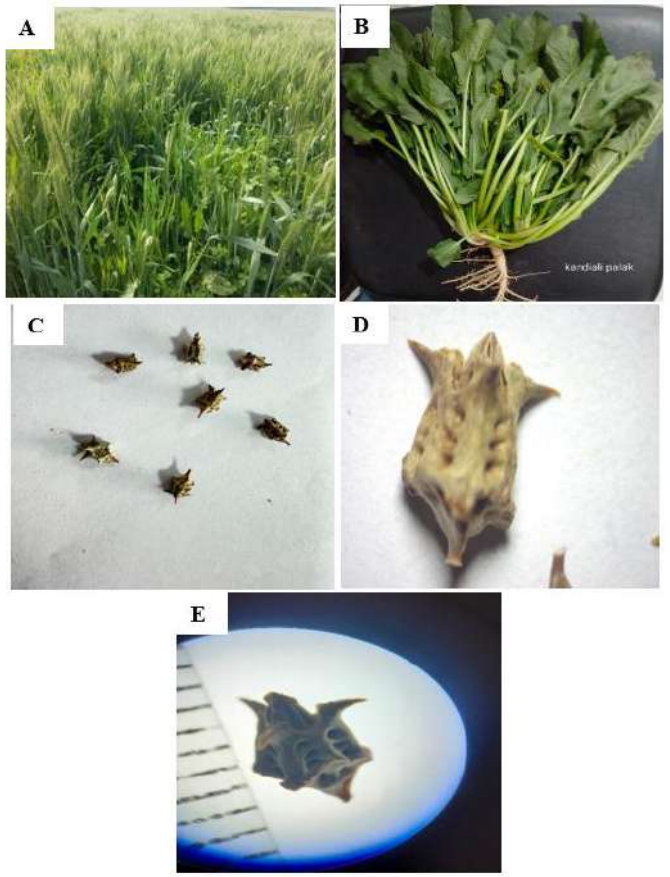
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| | | | | lower in T1(895.37g). Seed yield per hectare was higher in priming (2296.47 kg/ha) and lower in control (2050.42 kg/ha). | |
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**Experiment 4: Development of Digital Weed Seed Atlas: Ready Reckoner for Weed Seed Identification**

| S. No | Centre | List of identified weeds in the crop ecosystem | Remarks |
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| ***Wheat, Barley & Oats*** | | | |

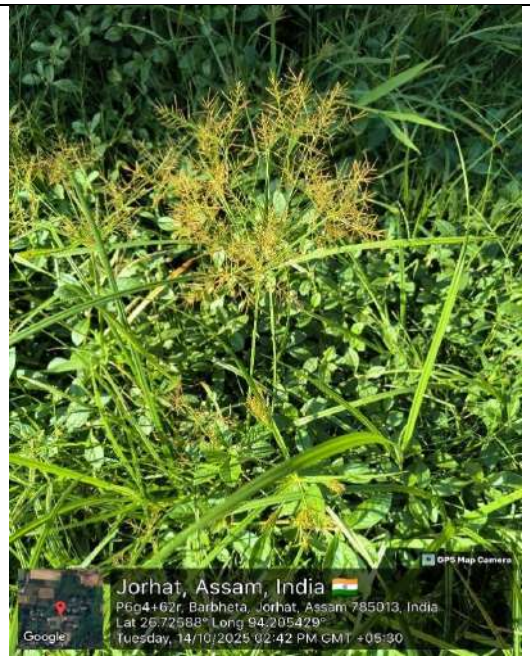
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| 1 | CCSHAU, Hisar | List of identified & collected weeds in crop fields (Wheat, barley & oat)<br>*Phalaris minor, Avena ludoviciana, Lolium temulentum, Vicia sativa, Raphanus raphanistrum, Tulipa sp., (11)* | Weeds as detailed below were found in Barley, wheat, mustard, and oat crops during Rabi 2024-25 in Hisar.<br>Jangli Dhania (*Spergula arvensis*), Senji (*Melilotus indicus*), Pit Papra (*Coronopus didymus or Lepidium didymum*), Johnson grass (*Sorghum halepense*), Jangli Sarson or London Rocket (*Sisymbrium irio*)<br>(Very well catalogued) |
| | | <br>*Jungli Dhania (Spergula arvensis)* | <br>**Pit Papra** *Coronopus didymus /Lepidium didymum* |
| | | <br>**Johnson grass (*Sorghum halepense*)** | <br>**Jangli Sarson (*Sisymbrium irio.*)** |

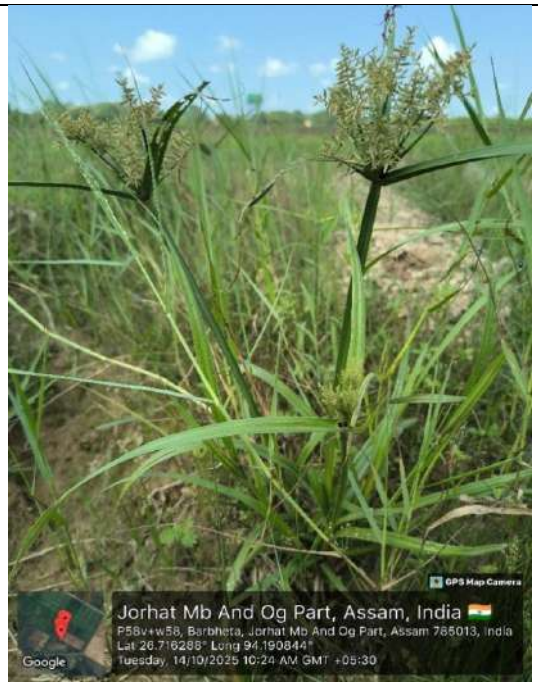
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| | | *Phalaris minor* –Little seed canary grass/Gullidanda<br>Family: Poaceae<br> | *Avena ludoviciana* – Wild oat/Jungli jai<br>Family: Poaceae<br><br>6- ventral side with fine longitudinal groove; 7- dorsal side; 8- longitudinal depression in upper half; 9- embryo position |
| 2 | PAU, Ludhiana | *Weed seeds catalogued: Malva parviflora L., Ischaemum rugosum Salisb., Amaranthus viridis L., Fumaria parviflora Lam., Eleusine indica (L.) Gaertn., Euphorbia hirta L., Spergula arvensis L., Eragrostis tenella (L.) P. Beauv., Eragrostis tenella (L.) P. Beauv., Rumex spinosus L., Ludwigia hyssopifolia (G. Don) Exell, Cenchrus catharticus Delile, Cichorium intybus L., Commelina benghalensis L., Digera arvensis Forssk (14)* | From fields of wheat, oat, paddy, maize and berseem. (very well documented) |

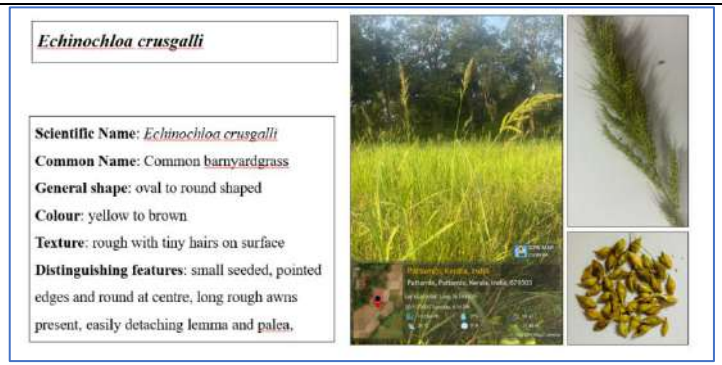
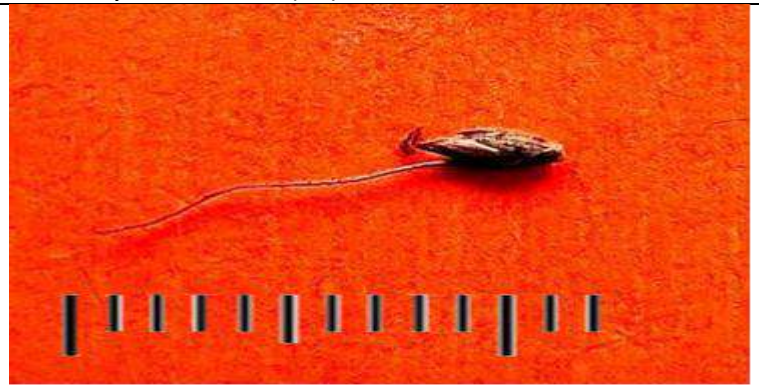
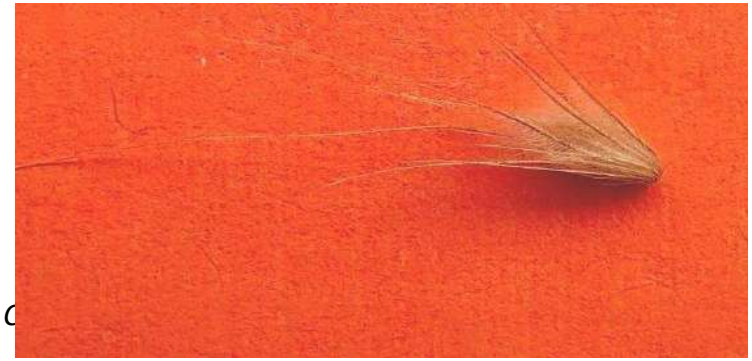
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| | |   *Malva parviflora* |   *Rumex spinosus* |
| 3 | SKNAU, Jobner | *Weeds collected from wheat field: Chenopodium album, Eragrostis cilianensis, Rumex dentatus, Phalaris minor Retz., Parthenium hysterophorus* L. (5). | |
| 4 | GBPUAT, Pantnagar | *Submitted weed seed specimens (properly dried and in good condition) to ICAR-NISST, RS, Bengaluru. (10)* | |

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| **Paddy** | | | |
| 1 | PAJANCOARI, Karaikal | A systematic survey of rice fields in Karaikal district resulted in the collection and documentation of 64 weed species across different stages of the cropping season, including before sowing, during the standing crop, and after harvest. | *Weeds catalogued: Stachytarpheta indica, Ageratum conyzoides, Melochia corchorifolia, Sida acuta, Eclipta alba, Convolvulus arvensis, Hibiscus vitifolius, Acalypha indica, Emilia sonchifolia, Phyllanthus maderaspatensis, Ludwigia octovalvis, Basilicum polystachyon, Phyllanthus virgatus, Xanthium strumarium, Croton bonplandianum, Corchorus aestuans, Bergia capensis, Ocimum gratissimum, Spermacoce alata, Melampodium divaricatum, Typha angustifolia, Sorghastrum nutans (22).* |
| | |  ***Stachytarpheta indica*** |  ***Ageratum conyzoides*** |
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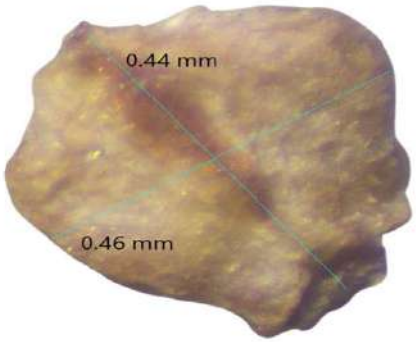
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| | |  ***Spermacocealata*** |  ***Bergia capensis*** |
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| 2 | AAU, Jorhat | *Weed species identified: Cyperus distans L.f., Ludwigia hyssopifolia, Cyperus odoratus L., Cyperus iria, Cyperus esculentus, Cyrtococcum trigonum, Eleocharis engelmannii, Ludwigia multiflora L., Echinocloa cruspavonis, Ottelia alismoides, Mimosa pudica, Ludwigia perrenis L., Cencrus purpureus (Schumach.) Morrone, Mentha aquatica, Ludwigia adscendens (L.), Eleusine indica (L.) Gaertn, Leucas aspera, Ageratum conyzoides, Eleocharis obtusa, Stachytarpheta indica. (20)* | Total of twenty weed species are documented and identified from different parts paddy field of AAU ICR farm**.** Out of all these *Cyperus spp.* is found as dominant and a total of five different species of *Cyperus* is recorded**.** |

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| | | *Cyperus distans* L.f. | *Cyperus odoratus* L. |

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| | | *Cyperus iria* | *Cyperus esculentus* |
| 3 | JNKVV, Jabalpur | The most recurring weeds of Rice and Soybean: *Cassia tora L., Echinochloa frumentacea, Echinochloa crus-galli, Celosia argentea L., Saccharum spontaneum, Cassia tora spp., Cyperus rotundus, Cyperus difformis L., Cyperus esculentus, Panicum repens. (10)* | |
| 4 | KAU, Pattambi | *Echinochloacrusgalli; Ludwigia perennis; Cyperus iria , Echinochloa crusgalli ; Isachnemiliacea; Echinochloa colona. (6)* | The study enabled the collection and morphological characterization of important weed seeds associated with paddy fields in the Pattambi region |

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| 5 | OUAT, Bhubaneshwar | *Weeds catalogued: Ammania genus, Oplismenus hirtellus, Cenchrus purpureus, Tridax procumbens, Mimosa pudica, Veronica peregrina, Celosia argentea, Ouret lanata, Eclipta prostrata, Dactylolectium aegyptium, Ludwigia octovalvis, Ageratum conyzoides, Scirpoides holoschoenus, Cyperus rotundus, Acmella oleraceae, Panicum virgatum, Pennisetum pedicellatum, Fimbristylis miliaceae, Fimbristylis miliaceae (19).* | |
| | | <br>*Oplismenus hirtellus* |  |
| ***Wheat*** | | | |

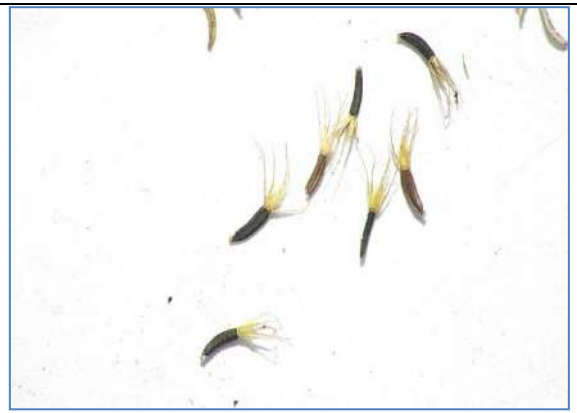
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| 1 | SHUATS, Prayagraj | *Chenopodium album, Sonchus oleraceus* | |
| ***Maize*** | | | |
| 1 | UAS, Bangalore | *Weeds catalogued: Cirsium arvense, Avena fatua, Convolvulus arvensis, Rumex dentatus, Spergula arvensis, Melilotus indicus, Coronopus didymus, Sorghum halpepense, Medicago denticulata (9).* | Multiple Crop fields |
| | |  ***Convolvulus arvensis*** | ***Rumex dentatus***  |
| 2 | UAS, Dharwad | *Antigonon leptopus, Dactyloctenium aegyptium, Cassia tora, Achyranthes aspera, Euphorbia hirta, Cardiospermum halicacabum, Echinochloa crus-galli, Setaria viridis, Eulalia molli, Amaranthus retroflexus, Euphorbia heterophylla, Sida rhombifolia, Megathyrsus maximus, Chloris barbata, Pueraria montana , Celosia argentea, Mimosa pudica.(17)* | Multiple Crop fields |
| ***Sorghum*** | | | |
| 1 | TNAU, Coimbatore | *Weeds catalogued: Acalypha indica, Amaranthus viridis Hook. f., Boerhavia erecta L., Brachiaria ramosa (L.), Dactyloctenium aegyptium, Digera arvensis Forssk., Dinebra retroflexa, Euphorbia hirta, Parthenium hysterophorus, Trianthema portulacastrum L., Setaria glauca (L.) P. Beauv. (11).* | |

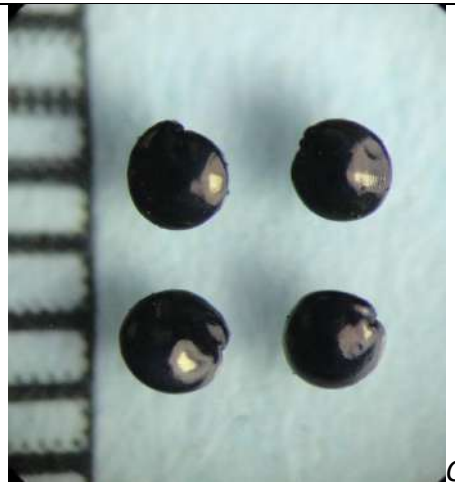
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| | | *Boerhavia erecta*<br><br> | *Brachiaria ramose*<br> |
| 2 | SKNAU, Jobner | *Weeds catalogued: Sorghum halepense (L.) Pers., Dactyloctenium aegyptium (L.) Willd., Amaranthus viridis Hook. f., Euphorbia hirta L., Leucas aspera L., Digera arvensis Forssk., Verbesina encelioides (Cav.) Benth., Echinochloa colona (L.) Link, Brachiaria ramosa (L.) Stapf., Eleusine indica (L.) Gaertn., Eragrostis amabilis (L.), Phyllanthus niruri L., Ipomoea pes-tigridis L., Commelina diffusa L., Cyperus rotundus L., Cyperus compressus L., Amaranthus spinosus L., Sesbania bispinosa (Jacq.) W. Wight, Trianthema portulacastrum L., Corchorus trilocularis L. (20).* | Weed seeds collected from sorghum and peralmillet fields. |

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| | | | *Amarathus viridis*<br> |
| ***Black Gram*** | | | |
| 1 | TNAU, Coimbatore | *Weed seeds catalogued: Acalypha indica, Amaranthus viridis Hook. f., Boerhavia erecta L., Chloris barbata, Dactyloctenium aegyptium, Digera arvensis Forssk., Digitaria sanguinalis, Echinochloa colona (L.) Link, Parthenium hysterophorus, Trianthema portulacastrum L. (10).* | |
| | | *Chloris barbata*<br> | *Digitaria sanguinalis*<br> |

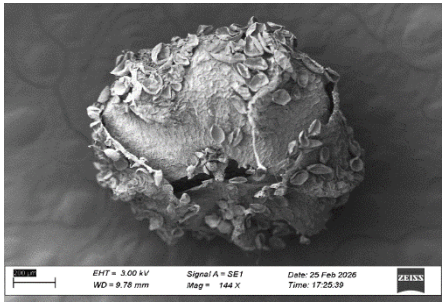
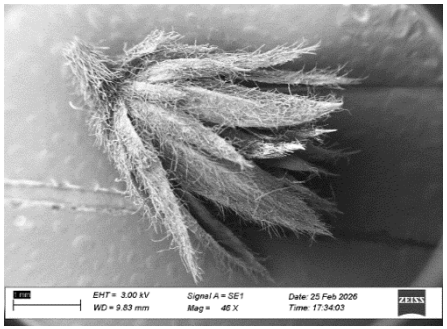
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| 2 | MPKV, Rahuri | *Weed seeds catalogued:*<br>*Amaranthus graecizans L., Amaranthus viridis L., Dactyloctenium aegyptium (L.) Willd., Tridax procumbens L., Physalis minima L., Leptochloa chinensis (L.) Nees, Silene gallica L., Aerva lanata (L.) Juss., Senna obtusifolia (L.), Chloris barbata Sw., Euphorbia hirta L., Sida acuta Burm., Ageratum conyzoides L., Eragrostis pilosa L., Digitaria ciliaris L., Ipomoea obscura L., Cynodon dactylon L., Cyperus rotundus L., Phalaris minor Retz., Conyza bonariensis (L.) Cronquist, Lycium edgeworthii L., Mimosa diplotricha C. Wright, Sonchus oleraceus L., Desmodium triflorum (L.) DC., Alternanthera sessilis L., Chloris barbata Sw., Mukia maderaspatana (L.) M. Roem., Parthenium hysterophorus L., Sida cordifolia L., Mollugo pentaphylla L., Bidens pilosa L. (32).* | |
| | | *Amaranthus graecizans*<br> | *Phisalis minima*<br> |

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| | | *Rynchosia minima*<br> | *Stylosanthes hamata*<br> |
| 3 | PDKV, Akola | *Weed seeds catalogued: Cyperus rotundus, Commelina benghalensis, eusine indica(L.), Euphorbia geniculata Ortego, Parthenium hysterophorus L., Echinochloa colona , Dactyloctenium aegyptium, Aristolochia bracteolate, Digera arvensis, Lagasca mollis, Ageratum conyzoides, Abelmoschus moschatus, Phyllanthus niruri, Euphorbia hypericefolia, Corchorus accutangulus, Alternanthera triandra, Dinebra arabica, Psorolia corrylofolia (17).* | |
| | | *Cyperus rotundus* | *Commelina benghalensis* |

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| ***Pigeon Pea*** | | | |
| 1 | PJTSAU, Hyderabad | *Weed seeds catalogued: Echinochloa colona, Cyperus rotundus, Digera arvensis, Amaranthus viridis, Dactyloctenium aegyptium, Parthenium hysterophorus, Cleome viscose (7)* | Weed seeds identified from paddy, maize, and pigeon pea |
| | | <br>*Celosia argentea* | <br>*Ageratum conyzoides* |
| ***Soybean:*** *ICAR-NISST, RS, Bengaluru* | | | |

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| 1 | *ICAR-NISST, RS, Bengaluru* | *Celosia argentea ; Cenchrus setiger ; Echinochloa crus-galli (4)* | |
| | |  *Celosia argentea* |  *Celosia argentea* |
| | |  *Cenchrus setiger* |  *Cenchrus setiger* |
| 2 | VNMKV, Parbhani | *Weed seeds catalogued: Euphorbia Germculata, Digera arvensis, Alternanthera Spp, Cassia tora, Parthenium hysterophorus L., Phylanthus niruri, Achyaranthas aspera,* | Weed seeds were collected from soybean and safflower fields. |

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| | | *Echinochloa colona, Brachinaria deflexa, Galinsoga partvflora, Merremia emarginata, Amischophacelus cuculala (12).* | |
| ***Groundnut*** | | | |
| 1 | TNAU, Coimbatore | *Weed seeds catalogued: Acalypha indica, Amaranthus viridis Hook. f., Chloris barbata, Cyperus haspan L., Dactyloctenium aegyptium, Datura metel L., Digera arvensis Forssk., Digitaria sanguinalis, Echinochloa colona (L.) Link, Parthenium hysterophorus, Trianthema portulacastrum L., Tridax procumbens.(11)* | |
| | | *Cyperus haspan*   |  *Tridax procumbens* |
| 2 | JAU, Junagadh | *Weed seeds catalogued: Celosia argentea L., Vernonia cinerea (L.) Less, Digera arvensis Forssk., Dichanthium annulatum (Forssk.) Stapf., Eragrostis pilosa L., Dactyloctenium aegyptium L., Parthenium hysterophorus L., Euphorbia hirta L., Echinochloa colona (L.) Link, Tridax procumbens L., Achyranthes aspera L., Cynodon dactylon (L.) Pers., Cyperus rotundus L., Phyllanthus fraternus / P. niruri Webster (14).* | Microscopic view was very well captured. Very well catalogued. |

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| | | *Celosia argentea*<br> | *Celosia argentea*<br> |
| | | *Vernonia cinerea*<br> | *Vernonia cinerea*<br> |
| **Cotton** | | | |
| 1 | ICAR-CICR, Nagpur | *Weed seeds catalogued: Cox Comb or Fox Palm, Celosia argentea, Resham Kata, Alternanthera spp., Wild Tulasi, Ocimum spp., Saratta / Aghada, Achyranthes spp., Dipmala, Leonotis nepetifolia, Kanghi / Bhala, Ocimum spp., Wild Jute, Corchoris trilocularis, Bauchi, Cherulia spp., Congress weed, Parthenium spp., Tarota, Cassia tora, Gokharu, Xanthium strumarium, Shevara, Desmodium spp. (12).* | |

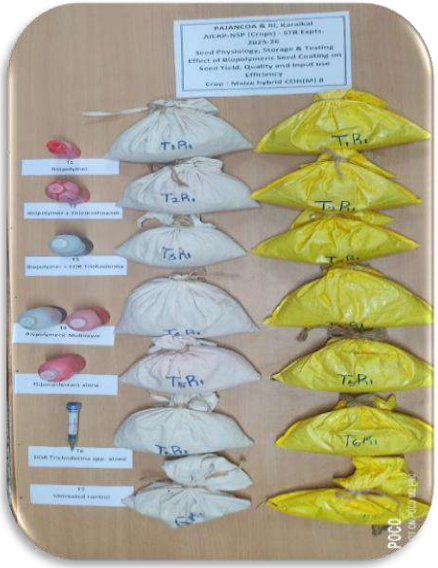
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| 2 | MPKV, Rahuri | *Weed seeds catalogued: Portulaca oleracea L., Echinochloa colona (L.) Link, Boerhavia erecta L., Amaranthus viridis L., Tridax procumbens L., Achyranthes aspera L., Cenchrus setigerus Vahl, Bidens pilosa L., Chloris barbata Sw., Sonchus oleraceus L., Dactyloctenium aegyptium (L.) Willd., Aristida adscensionis L., Conyza bonariensis (L.) Cronquist, Eragrostis amabilis (L.) Wight, Euphorbia hirta L., Cardiospermum halicacabum L., Ipomoea triloba L., Sida cordifolia L., Alternanthera sessilis L., Amaranthus viridis L., Achyranthes spinosus L., Parthenium hysterophorus L., Trianthema portulacastrum L., Cyperus rotundus L., Setaria pumila (Poir.) Roem. & Schult., Pennisetum pedicellatum Trin., Commelina forskaolii Vahl., Mesosphaerum suaveolens (L.) Kuntze, Senna tora (L.) Roxb., Abutilon indicum L., Ipomoea hederifolia L., Eragrostis pilosa L. (30).* | |
| **Safflower** | | | |
| 1 | MPKV, Rahuri | *Weed seeds catalogued: Aristida adscensionis L., Sida cordifolia L., Echinochloa colona (L.) Link, Cyperus rotundus L., Rhynchosia minima L., Cissampelos pareira L., Stylosanthes hamata L., Sonchus oleraceus L., Eragrostis* | |

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| | | *unioloides L., Amaranthus viridis Hook. f., Convolvulus arvensis L., Cynodon dactylon L., Eragrostis pilosa L., Alternanthera sessilis L., Parthenium hysterophorus L., Chloris barbata Sw., Conyza bonariensis (L.) Cronquist, Tridax procumbens L., Cardiospermum halicacabum L., Trichodesma indicum (L.) Lehm., Vigna trilobata L., Euphorbia hirta L. (21).* | |

**Experiment 5: Effect of Biopolymeric Seed Coating on Seed Yield, Quality and Input Use Efficiency**

| S. No | Centre | Varieties | Treatments | Remarks | Conclusion |
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| • To evaluate the impact of ICAR-IIOR biopolymer-based seed coating formulations on seed yield, seed quality, and input use efficiency across multiple crops and agro-climatic zones.<br>• To assess the storability and shelf-life enhancement conferred by biopolymer-based seed coatings under ambient storage conditions. | | | | | |
| **Maize: PAJANCOA&RI, Karaikal; ICAR-IARI, New Delhi; TNAU, Coimbatore; UAS, Bengaluru** | | | | | |
| 1 | PAJANCOA&RI, Karaikal | COH(M) 8 | T1: Biopolymer (BP) alone<br>T2: BP+ Carboxin + thiram<br>T3: BP+ Rhizobium<br>T4: BP+ IIOR Trichoderma (Biocoat)<br>T5: Biopolymeric multilayer (ML)<br>T6: Carboxin + thiram alone | *Laboratory Analysis*<br>Biopolymeric multilayer seed coating (T4) was the most effective treatment, recording 98% germination, 80% first count, 26.15 cm root length, 1.709 g dry matter/10 seedlings, SVI-I of 3902 and SVI-II of 167. It was followed closely by BP + Thiamethoxam (T2), which recorded 98% germination, 1.689 g dry matter, SVI-I of 3852 and SVI-II of 166. Trichoderma-based treatments were particularly effective in improving shoot length. Overall, biopolymeric multilayer coating may be considered the best | Biopolymeric multilayer seed coating was found to be most effective. |

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| | | | T7: Rhizobium alone<br>T8: Uncoated (control) | seed-coating treatment for enhancing germination, seedling growth, and vigour.<br><br>*Field observations*<br>Biopolymeric multilayer seed coating was the best treatment, recording the highest plant stand establishment (99%), seeds per cob (434), test weight (36.32 g), grain yield per plant (143.81 g), grain yield per plot (8.12 kg), grain yield per hectare (6764 kg/ha) and harvest index (0.35). It was followed by BP + Thiamethoxam, particularly for seeds per cob and grain yield per hectare. Overall, biopolymeric multilayer coating may be considered the most effective treatment for improving crop establishment, yield attributes and grain productivity.<br><br>*Storage analysis*<br>Germination declined with increase in storage duration, from an overall mean of 95.9% initially to 95.3% at 2 MAS and 94.1% at 4 MAS. Among treatments, T4 – Biopolymeric multilayer was superior, maintaining the highest germination of 95.7% at 4 MAS, compared with 91.7% in the untreated control. Among containers, HDPE bags maintained slightly higher germination, especially at 4 MAS (94.4%) compared with cloth bags (93.7%). Therefore, biopolymeric multilayer coating | |

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| | | | | combined with HDPE storage was most effective for maintaining seed germination during storage up to 4 months. | |
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| 2 | ICAR-IARI, New Delhi | HQPM-5 Improved | -do- | The highest yield per plant was recorded in Biopolymer + Thiamethoxam (T2: 165.65 g/plant), followed by Biopolymer + Trichoderma (T3: 161.35 g/plant) and Thiamethoxam alone (T5: 158.43 g/plant).<br>Among the seed coating treatments, Biopolymer + Trichoderma (T3) recorded the highest final plant stand and maximum yield per hectare, while Biopolymer + Thiamethoxam (T2) recorded the highest number of seeds per cob, yield per plant, yield per plot and harvest index.<br>Biopolymer alone recorded the best storability. It maintained the highest final germination at 6 months (82.5%) and also retained higher first count germination (70.0%). This indicates better maintenance of seed vigour and viability during storage. BP + Thiamethoxam (T2) performed almost on par with T1. It recorded 81.5% final germination and 70.0% first count at 6 months, showing good retention of seed quality. | Among the seed coating treatments, Biopolymer + Trichoderma (T3) recorded the highest final plant stand and maximum yield per hectare, while Biopolymer + Thiamethoxam (T2) recorded the highest number of seeds per cob, yield per plant, yield per plot and harvest index.<br><br>Whereas, biopolymer alone recorded the best for storability. |

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| 3 | TNAU, Coimbatore | COH(M)11 | -do- | Final germination ranged from 96% to 98%, with the highest germination recorded in BP + Thiamethoxam and Biopolymer multilayer, each with 98% germination.<br>Overall, the results suggest that biopolymer multilayer coating and BP + Thiamethoxam improved seedling vigour and early seedling growth compared with uncoated seeds, although final germination was not significantly affected.<br><br>The maximum seed yield per plot was observed in T4 – Biopolymer multilayer (9.54 kg/plot), followed by T2 – BP + Thiamethoxam (9.05 kg/plot) and T5 – Thiamethoxam alone (8.94 kg/plot).Among all treatments, T4 – Biopolymer multilayer recorded the highest seed yield per plant, seed yield per plot, seed yield per hectare, harvest index and cost– | Biopolymer multilayer coating or BP + Thiamethoxam found to be effective. |

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| | | | | benefit ratio. It was statistically at par with T2 – BP + Thiamethoxam for seed yield per plant<br>Storability Studies: Among the treatments, T4 – Biopolymer multilayer (ML) recorded the highest germination throughout storage. It maintained a mean germination of 97% in gunny bag and 98% in HDPE bag. At 6 months of storage, T4 retained 96% germination in gunny bag and 97% in HDPE bag, showing superior storability. The lowest germination was recorded in T7 – Uncoated control, with a mean germination of 94% in both packaging materials. At 6 months of storage, T7 declined to 92% in gunny bag and 93% in HDPE bag, indicating comparatively faster deterioration in uncoated seeds. | |
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| 4 | UAS, Bengaluru | MAH-20-45 | -do- | Biopolymer (BP) alone recorded the best overall performance. It registered the highest final plant stand establishment after 5 weeks | Among the treatments, T1 – Biopolymer (BP) alone was the best-performing treatment, showing |

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| | | | | (65.0 plants), number of cobs per plant (1.9), number of seeds per cob (1089.0), seed yield per plot (30.7 kg/plot), seed yield per hectare (25,608 kg/ha) and harvest index (90.6%). Among the treatments, T1 – Biopolymer (BP) alone was the best-performing treatment, showing superior plant establishment, grain formation, grain yield and harvest index. T4 – Biopolymeric multilayer (ML) was the second-best treatment, followed by T3 – BP + IIOR *Trichoderma* spp. for grain yield. The untreated control (T7) recorded the lowest values for most parameters. Overall, the results indicate that biopolymer-based seed coating, particularly BP alone and biopolymeric multilayer coating, improved crop establishment, yield attributes and seed yield compared with untreated seed. | superior plant establishment, seed formation, seed yield and harvest index. |
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| **Soybean: JNKVV, Jabalpur; PAU, Ludhiana; ICAR – NISST, RS, Bengaluru; VNMKV, Parbhani** | | | | | |

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| 1 | JNKVV, Jabalpur | | T1:Biopolymer (BP) alone T2: BP+ Carboxin + thiram T3: BP+ Rhizobium T4: BP+ IIOR Trichoderma (Biocoat) T5: Biopolymeric multilayer (ML) T6: Carboxin + thiram alone T7:Rhizobium alone T8: Uncoated (control) | The highest seed yield per plant was recorded in T3 – BP + *Rhizobium* (12.33 g/plant), followed by T5 – Biopolymeric multilayer (9.73 g/plant). Based on the CD value of 2.79 g, T3 was significantly superior to most treatments and statistically at par with T5.<br>For seed yield per plot, T3 – BP + *Rhizobium* recorded the highest value (1.46 kg/plot), followed closely by T1 – BP alone (1.44 kg/plot) and T6 – Carboxin + Thiram alone (1.43 kg/plot). The lowest plot yield was observed in T2 – BP + Carboxin + Thiram (1.19 kg/plot).<br><br>Regarding storage studies, Carboxin + Thiram-based treatments were superior for maintaining seedling vigour, irrespective of packaging material. After 7 months, germination observed in Untreated control under gunny bag (50.00%), followed by BP + Carboxin + Thiram under HDPE (48.66%) and Untreated control under HDPE (48.66%). | Among the treatments, T3 – BP + *Rhizobium* performed best, recording the highest pods per plant, seeds per pod, seed yield per plant, seed yield per plot and seed yield per hectare. |

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| 2 | PAU, Ludhiana | SL 958 | -do- | The highest seed yield per plot was recorded in T1 – Biopolymer 2 only (2.95 kg/10 m²), followed by T5 – Carboxin + Thiram (2.92 kg/10 m²) and T2 – Biopolymer 1 + Carboxin + Thiram (2.89 kg/10 m²).<br><br>With respect to storage studies, untreated as well as treated seeds failed to meet IMSCS after five months of seed storage. | Overall, all treatments were statistically at par for plant stand, biomass production, stover yield, seed yield and harvest index. However, on a numerical basis, T1 – Biopolymer 2 only recorded the highest seed yield and harvest index, while T6 – Rhizobium recorded the highest total biomass and stover yield. Therefore, Biopolymer 2 alone showed a slight numerical advantage for economic yield. |
| 3 | ICAR – NISST, RS, Bengaluru | JS 335 | T1- Biopolymer (BP) alone<br>T2 -Biopolymer + Carboxin + thiram<br>T3 – Biopolymer + Rhizobium<br>T4 -Biopolymer + Trichoderma<br>T5 - Biopolymeric multilayer (ML)<br>T6 - Carboxin + thiram alone<br>T7 -Rhizobium alone<br>T8 - Uncoated (control) | Seed yield per plant varied significantly among treatments, ranging from 15.80 to 23.83 g. The maximum seed yield per plant was observed in T1 (23.83 g) and T6 (22.13 g), which were statistically at par with each other and significantly superior to the other treatments.<br>Seed yield per plot ranged from 2.00 to 3.15 kg, with T2 (3.15 kg) and T5 (3.05 kg) recording significantly higher yields. These treatments effectively translated plant population and yield attributes into economic yield. Interestingly, despite lower per-plant yield, T2 recorded higher plot yield due to its higher plant stand, indicating that yield per | Overall, the study demonstrates that T1 (Biopolymer (BP) alone) and T5 (Biopolymeric multilayer (ML) are the most effective treatments, significantly improving both yield attributes and final yield |

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| | | | | unit area is strongly influenced by plant population density.<br><br>At 6 months of storage, only T2 (Biopolymer +Carboxin +thiram), T3 (Biopolymeric multilayer), and T4 (Carboxin +thiram) could be evaluated, as T1 (Biopolymer alone) and T5 (Uncoated (control)) were heavily infested with pests, indicating poor storage conditions. Among the remaining treatments, T4 consistently recorded higher germination, shoot length, root length, and vigour indices, demonstrating superior storability. | |
| 4 | VNMKV, Parbhani | MAUS 612 | -do- | Among treatments, T5 (Biopolymeric multilayer (ML)) recorded superior performance with highest plant stand (93.0%), number of pods per plant (51.05), seeds per pod (2.73), seed yield per plant (12.92 g), seed yield per plot (2.64 kg) and seed yield (24.50 q/ha). It also showed highest germination after treatment (93.0%), vigor index-I (2589.12), and maximum net monetary return (₹102068.10) with highest B:C ratio (1.80).<br>Treatment T4 (Biopolymer + Trichoderma) was the next best, | Biopolymeric seed coating significantly improved soybean productivity and seed quality. Among treatments, T5 (Biopolymeric multilayer (ML)) was found most effective, resulting in higher yield, better seed vigor, and maximum economic returns. |

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| | | | | showing comparable performance for plant height, yield and harvest index. Lower performance was observed in T8, which recorded minimum yield (17.37 q/ha), germination (85.50%) and economic returns.<br>The study indicates that seed viability declines progressively with storage duration, but packaging material plays a crucial role in maintaining seed quality. HDPE bags proved superior to gunny bags in preserving germination percentage. Among treatments, T5 performed better under storage conditions. | |
| **Groundnut: BSKKV, Dapoli; OUAT, Bhubaneswar; JAU, Junagadh; ANGRAU, Guntur** | | | | | |
| 1 | BSKKV, Dapoli | Konkan Bhuratna | T1.Biopolymer (BP) alone T2.BP+ Carbendazim T3.BP+ Rhizobium T4.BP+ IIOR Trichoderma (Biocoat) T5. BP + Trichoderma + Rhizobium T6. BP + Carbendazim + Thiamethoxam T7. Carbendazim alone | T5 treatment (BP + *Trichoderma* + *Rhizobium)* recorded highest dry pod yield (3499.28 kg/ha), kernel yield (2776.09 kg/ha), shelling percentage (79.29%), haulm yield (3903.46 kg/ha), biological yield (7402.75 kg/ha) and harvest index (37.50).<br>T3 – BP + *Rhizobium* was the next best treatment, recording 3410.70 kg/ha dry pod yield, 2651.89 kg/ha kernel yield and 7308.64 kg/ha biological yield. T8 – *Rhizobium* alone and T7 – Carbendazim alone also showed | Among all treatments, T5 (BP+*Trichoderma*+*Rhizobium*) recorded the highest pods per plant, seeds per pod, test weight, dry pod yield, kernel yield, shelling percentage, haulm yield, biological yield and harvest index. |

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| | | | T8.Rhizobium alone<br>T9.Uncoated (control) | comparatively better yield performance.<br>The seeds of groundnut variety KonkanBhuratna coated with BP+*Rhizobium* and BP+*Trichoderma*+*Rhizobium* stored in HDPE bag maintained germination above IMSCS (75%) up to six months of storage period from the date of first test at Konkan condition under ambient condition. | |
| 2 | OUAT, Bhubaneswar | VRI-10 | $T_1$: Biopolymer alone<br>$T_2$: Biopolymer + Carbendazim<br>$T_3$: Biopolymer + *Rhizobium*<br>$T_4$: Biopolymer + IIOR *Trichoderma* (Biocoat)<br>$T_5$: Biopolymeric multilayer<br>$T_6$: Carbendazim alone<br>$T_7$: *Rhizobium* alone<br>$T_8$: Uncoated (Control) | Coating with Biopolymer + Rhizobium ($T_3$) resulted in higher plant stand of 85.0%, followed by Biopolymer + Carbendazim ($T_2$–84.33%), while the uncoated Control ($T_8$) resulted in lowest plant stand of 71.0%. For other yield attributing parameters, the trend was similar. Highest seed yield was recorded from $T_3$ (2383.26 q/ha), which was 20.04% higher over the uncoated Control ($T_8$ - 1985.38 q/ha). The best treatment recorded highest harvest index of 41.75% and C : B ratio of 2.10.<br>Among the treatments, T3 – Biopolymeric multilayer was the best treatment for improving seed vigour, as it recorded the highest SVI-I and SVI-II with high germination. T1 – | $T_3$: Biopolymer + Rhizobium found to be effective in increasing seed yield. |

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| | | | | Biopolymer alone recorded the highest final germination and also maintained good vigour. | |
| 3 | JAU, Junagadh | | -do- | Treatment $T_5$(Biopolymeric multilayer (ML)) recorded significantly superior performance with respect to final plant stand at 28 DAS (93.33%), number of pods per plant (22.33), pod yield per plant (23.57 g), pod yield per plot (2.16 kg) and pod yield per hectare (3195 kg/ha).<br>For storage studies, first count and germination were non-significant at 2 months after storage, no distinct statistical differences were observed among treatments for these parameters. | $T_5$ (Biopolymeric multilayer (ML)) in groundnut produced higher seed yield (3195 kg/ha) and total income (₹2,43,645/ha) compared to the uncoated control. It resulted in greater net returns (₹1,43,787/ha) with a higher cost–benefit ratio (2.44) than the control (1.67). |
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| 4 | ANGRAU, Guntur | | -do- | Among the treatments, T5 (BP multilayer)recorded thehighest initial plant population (388 plants/12 m²), number of pods per plant (28), seeds per pod (3.0), seed yield per plant (21.6 g), seed yield per plot (2119 g), and seed yield (1765.7 kg/ha)**.** | Biopolymer multilayer seed treatment (BP multilayer) was the most effective treatment in enhancing plant establishment, yield attributes, and seed yield, followed by BP + Rhizobium |
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| **Chickpea: UAS, Raichur; JNKVV Jabalpur; PDKV Akola; ICAR-IARI, New Delhi** | | | | | |
| 1 | UAS, Raichur | JG-11 | T1.Biopolymer (BP) alone T2.BP+ Carboxin + thiram T3.BP+ Rhizobium T4.BP+ IIOR Trichoderma (Biocoat) T5. Biopolymeric multilayer (ML) T6. Carboxin + | $T_2$ (Biopolymer + Carboxin + Thiram) was recorded the highest final plant stand establishment (95.57 %), plant height (32.27 cm), number of pods per plant (40.86), number of seeds per pod (1.77), 100-seed weight (26.34 g) seed yield per plot (3.64 kg), seed yield per plant (18.77 g), seed yield per hectare (3032 kg) and harvest index (52.33). | Biopolymer-based seed coating in combination with Carboxin and Thiram significantly improved growth and yield attributes compared to the control in chickpea |

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| | | | thiram alone T7.Rhizobium alone 8.Uncoated (control) | Among the different seed treatments, $T_2$ (Biopolymer + Carboxin + Thiram) recorded comparatively superior performance for all seed quality parameters upto 7 months of storage. The treatment $T_2$ recorded higher first count (81.50), seed germination (91.00%) and lower seed moisture content (10.00 %). | |
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| 2 | PDKV, Akola | | -do- | The highest seed yield per plant was observed in T4: BP + IIOR Trichoderma (7.97 g), followed by T3: BP + Rhizobium (6.42 g) and T7: Rhizobium alone (5.71 g). Seed yield per plot ranged from 1.72 to 2.28 kg. The highest seed yield per plot was recorded in T4: BP + IIOR Trichoderma (2.28 kg), followed by T3: BP + Rhizobium (2.17 kg) and T7: Rhizobium alone (2.10 kg), while the lowest seed yield per plot was recorded in T8: uncoated control (1.72 kg). | T4: BP + IIOR Trichoderma (Biocoat) proved to be the most effective treatment, recording higher pods per plant, seeds per plant, test weight, seed yield per plant, seed yield per plot, seed yield per hectare. |

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| 3 | JNKVV, Jabalpur | **In Progress** | | | |
| **Mustard: ICAR-IARI, RS Karnal; UBKV, Pundibari; CCS HAU, Hisar; AU, Kota** | | | | | |
| 1 | ICAR-IARI, RS Karnal | PDZM 31 | T1: Biopolymer 2 Only<br>T2: Biopolymer 1 + Carbendazim<br>T3: Biopolymer 2 + *Trichoderma*<br>T4:Biopolymeric Multilayer Coating (ML) (Layer 1: Biopolymer 2 + *Trichoderma* + Layer 2: Biopolymer 1 + Carbendazim)<br>T5:Carbendazim Only<br>*T6:Trichoderma* Only<br>T7: Control | Seed yield per plant (g) was highest in Biopolymer 1 + Carbendazim (100.99 g), followed by Biopolymer 2 only (95.43 g), suggesting that integration of biopolymer with fungicide enhances individual plant productivity. The lowest value was observed in the control (71.82 g), indicating a clear beneficial trend of treatments.<br>Seed yield per plot (kg) and yield per hectare followed a slightly different pattern, with Trichoderma only treatment recording the highest values (5.839 kg plot$^{-1}$ and 4866 kg ha$^{-1}$). This indicates that although per plant yield was moderate, better field-level performance or plant population compensation may have contributed to higher overall productivity.<br><br>Regarding storage studies, the highest germination was recorded in Trichoderma only (96.67%) and Carbendazim only (96.00%), followed closely by coated treatments.<br>The control showed comparatively lower germination (92.00%), suggesting slight deterioration without treatment. | Taken together, the results indicate that biopolymeric seed coating treatments exert a consistently positive but largely non-significant effect on growth, yield attributes, and productivity of mustard (PDZM 31), with clearer benefits reflected in seed quality (test weight) and numerical yield improvements. The lack of statistical significance in most traits suggests that the technology is stable but requires further validation to confirm consistency. |

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| 2 | UBKV, Pundibari | PDZM 31 | -do- | Minimum yield per plant was observed in case of T7 (control) i.e., 3.82g. All the other treatments were statistically at par with the control except T5 (Carbendazim alone). Yield per plant was significantly higher in case of T5 i.e., 5.44g from control.<br>Similarly, significantly higher plot yield (1.14kg) was observed for T5 and calculated maximum yield was observed for T5 i.e., 950kg. All the other treatments were statistically at par in terms of both yield/plot and yield/ha.<br><br>W.r.t storage, there was non-significant difference among the treatments in both terms of first count percentage and germination percentage during very initial month of storage (i.e., August 2025). However, significant | Carbendazim alone proved to be effective w.r.t seed yield. |

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| | | | | deterioration in both first count % and germination percentage was observed in T1 (Biopolymer alone) (89%) from control T7 (95%). Other treatments were at par with the untreated control (T7). | |
| 3 | CCS HAU, Hisar | In Progress | | | |
| 4 | AU, Kota | | | Seed yield per ha (q) was exhibited maximum in biopolymer + carbendazim (12.80) followed by biopolymer multilayer (11.72) and carbendazim alone (10.78) which is 91.62 %, 75.44% and 61.37 % higher than uncoated (control).<br><br>Seed quality parameters exhibited a gradual decline with the advancement of storage period in biopolymers seed coating; however, the rate of deterioration was higher in biopolymers alone and multilayer compared to uncoated. Biopolymer + carbendazim and Carbendazim alone were maintained higher germination and vigor for a longer duration, showing comparatively better storability. | Biopolymer + carbendazim was found more effective for highest seed yield in quality mustard followed by biopolymer multilayer and carbendazim alone. |
| **Cotton: ICAR-CICR, Nagpur; JAU, Junagadh; MPKV, Rahuri; ICARCICR, RS, Coimbatore** | | | | | |
| 1 | ICAR-CICR, Nagpur | ICAR-CICR PKV-081 Bt | T1: Bio-polymer 1 (IIOR supplied) + Imidachlorprid (Confidor)<br>T2: Gaucho<br>T3: Untreated control | The maximum number of bolls per plant was recorded in T5 (28.80), followed by T2 (27.03) and T3 (25.73).<br><br>The highest seed cotton yield per plant was recorded in T5 (78.09 g/plant), followed by T2 (76.28 g/plant) and T3 (74.62 g/plant). However, this parameter was non-significant, | Among all treatments, T5 was the best-performing treatment, recording the highest final plant stand, bolls per plant, seeds per boll, ginning outturn, seed cotton yield per plant, seed cotton yield per plot, seed cotton yield per hectare, harvest index and B:C ratio. |

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| | | | T4: Bio polymer 2 (IIOR supplied)<br>T5: Bio polymer 2 + Tricho (IIOR supplied)<br>T6: Bio polymer 2 (IIOR supplied) + CICR Microbial<br>T7: Layer coating (L1 supplied by IIOR + Imidachloprid/Confidor) | so the differences should be treated as numerical trends only.<br><br>No significant difference observed among treatments for seed germination and other seedling growth parameters even after storage for 6 months storage. | |
| 2 | JAU, Junagadh | PKV-081 Bt | $T_1$ : Biopolymer (BP) alone<br>$T_2$ : BP+ Imidacloprid<br>$T_3$ : BP+ CICR microbial formulation<br>$T_4$ : BP+ IIOR *Trichoderma harzianum* (Biocoat)<br>$T_5$ : Biopolymeric multilayer (ML)<br>$T_6$ : Imidacloprid alone<br>$T_7$ : CICR microbial formulation alone | Treatment $T_5$(Biopolymeric multilayer (ML))recorded significantly higher number of bolls per plant (43.33), lint yield per plant (30.21 g), lint yield per hectare (554 kg/ha), seed yield per plant (86.27 g) and seed yield per hectare (1583 kg/ha).<br><br>Treatments $T_1$(Biopolymer (BP) alone) and $T_4$(Imidacloprid alone) were found at par with $T_5$(control) for vigour index-I at 4 MAS. At 6 MAS, treatment $T_1$(Biopolymer (BP) alone) recorded significantly higher vigour index-II (7182.78) and remained at par with other treatments. Based on the results of 6 months of storage, it can be concluded that cotton seeds can be stored up to 6 months in HDPE bags with or without coating of biopolymers. | The biopolymer-based seed coating treatment $T_5$(Biopolymeric multilayer (ML)) in cotton produced higher seed yield (1583 kg/ha) and total income (₹1,15,673/ha) compared to the uncoated control, resulting in greater net returns (₹56,270/ha) with a higher cost–benefit ratio (1.95) than the control (1.32), proving its economic superiority. |

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| | | | $T_8$ : Uncoated (control) | | |
| | | | |  | |
| 3 | MPKV, Rahuri | RHC-0688 | $T_1$:Biopolymer (BP2) alone<br>$T_2$:Biopolymer1 + Thiamethoxam<br>$T_3$:Biopolymer1 + CICR microbial formulation<br>$T_4$:Biopolymer 2+ IIOR Trichoderma (Biocoat)<br>$T_5$:Biopolymeric multilayer (ML) [$T_4$ + $T_2$]<br>$T_6$:Thiamethoxam alone<br>$T_7$:CICR microbial formulation alone | The cotton seeds treated with $T_5$: Biopolymeric multilayer (ML) $T_4$: Biopolymer 2+ IIOR Trichoderma $T_2$: Biopolymer1 + Thiamethoxam] recorded highest ginning outturn (34.46 %), seed cotton yield per plant (78.09 g per plant), (3.489 kg per plot) and 19.38 q per ha and B:C ratio (1.43). The treatment $T_2$: Biopolymer1 + Thiamethoxam recorded at par seed cotton yield.<br><br>It is concluded that the desi cotton seeds treated with $T_5$: Biopolymeric multilayer (ML) $T_4$: Biopolymer 2+ IIOR Trichoderma $T_2$: Biopolymer1 + Thiamethoxam] recorded better storability when stored with HDPE bags. | Among all treatments, T5 was the best-performing treatment, recording the highest final plant stand, bolls per plant, seeds per boll, ginning outturn, seed cotton yield per plant, seed cotton yield per plot, seed cotton yield per hectare, harvest index and B:C ratio. |

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| 4 | ICAR-CICR, RS, Coimbatore | PKV-081 Bt | | Among the various treatments, T7 (Layer coating of T1 and T5) emerged as a top performer, recording the highest numerical plot yield of 2100.00 g/plot, the maximum plant height of 127.7 cm, and the best germination rate at 97.7%. T6 (CICR microbial + biopolymer 2) also showed superior results, achieving the highest number of bolls per plant at 31.3 and the maximum single plant yield of 83.1 g. | T7 – Layer coating (T1 + T5) recorded the highest germination, plant height and plot yield, indicating better overall crop establishment and field performance. |

## C. Seed Pathology

Under seed pathology, following experiments were conducted at different centres under AICRP on Seed (Crops) during 2025-26 viz., monitoring and detection of seed-borne diseases of significance in major crops; studies on seed health status of farmers saved seeds; standardization of detection methods for seed-borne pathogens of significance; development of eco-friendly low-cost input / indigenous technology for the production of disease-free soybean, chickpea and groundnut seeds; development of seed health standards for important seed-borne diseases; systematic studies for evaluation of alternative chemicals and microbial consortia for effective management of seed-borne pathogens of major crops; multi-location assessment of seed-borne viral pathogens in major pulse/soybean crops and development of integrated seed health management strategies. The highlights of achievements have been summarized for a quick inference from various experiments.

❖ **Experiment 1: Monitoring and detection of seed-borne diseases of significance in major crops**

**Crop: Paddy**

At ICAR-IARI, New Delhi, 218 seed samples of different varieties of paddy were collected from Ghaziabad, Noida, Gurgaon, Baraut and Meerut districts for detection of bun. None of the sample showed the incidence of bunt. In case of bacterial leaf blight both in farmers field in different villages as well as in seed production plots of IARI, this disease was observed in moderate severity in variety Pusa 1121 while in other varieties it was not so severe. Pusa Sugandh-5 showed incidence of false smut in farmers field in different villages of Noida and Ghaziabad whereas, PB 1509 showed incidence of false smut in farmers field in different villages of Noida and Meerut. Fifteen seed production plots were surveyed for the incidence of various seed borne diseases at IARI farm and it was observed that Grain discolouration and False Smut was observed in low to moderate severity.

At ANDUA&T Ayodhya surveys were conducted across Ayodhya, Amethi, Sultanpur, Unnao, and Azamgarh, to assess the prevalence of paddy diseases. Bunt incidence was relatively low, ranging between 0.05–0.2%. Brown spot (23–46%), bacterial leaf blight (34.4–44.4%), and false smut (7.93–15.87%) showed comparatively higher incidence. In contrast, diseases such as dirty panicle/grain discoloration, bacterial panicle blight, and Udbatta were observed at very low levels, appearing as minor diseases. *Bipolaris spp.* and *Curvularia spp*. found to be associated with grain discolouration.

At PJTSAU Hyderabad, the incidence of bacterial leaf blight (BLB) ranged from low (rating 1; 1–5% leaf area damage) to severe (rating 7; 26–50% damage), with the highest severity observed in Nizamabad, Khammam, and Karimnagar districts. Sheath rot incidence remained low to moderate (ratings 1–3), indicating lesions confined to the lower 20–30% of plant height. False smut incidence varied from low (<1% infected florets) to moderate (6–25%), with higher occurrence in Mahaboobnagar, Ranga Reddy, and Nizamabad districts,

particularly in variety RNR 15048 under poor crop management conditions. Grain discolouration was observed at low to moderate levels (ratings 1–3) across all surveyed districts. A total of 389 paddy seed samples, including processed (92), unprocessed (103), and farmers' samples (194), were collected and analyzed for bunt infection using the NaOH seed soak method. Of these, 130 samples (47.97%) tested positive, with infection ranging from 0.00% to 0.29%. Farmers' seed samples recorded the highest incidence (up to 0.29%), followed by unprocessed and processed seeds, highlighting the importance of seed quality management.



Grain Discoloration

Udabatta

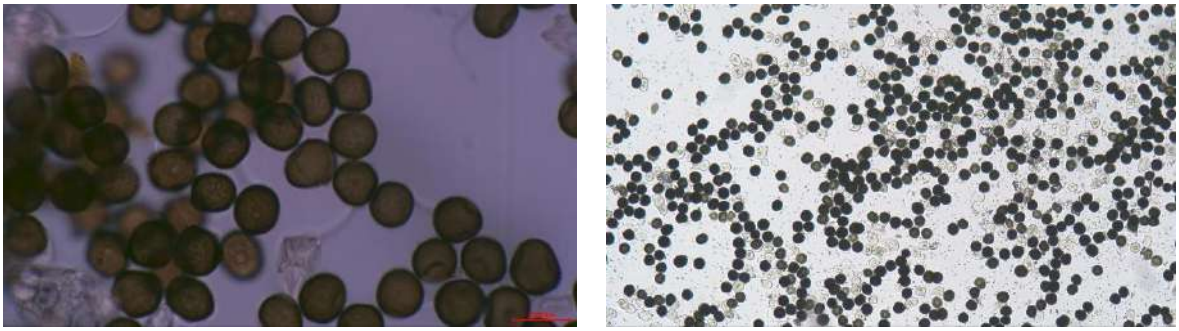
**Occurrence of paddy grain discolloration and Udabatta disease in farmer's field at ANDUAT, Ayodhya**

At GBPUAT, Pantnagar, analysis of 367 paddy seed samples collected from different areas revealed no bunt infection above certification standards. However, trace levels (0.01–0.02%) were detected in varieties PB 1509 and HKR 47 from limited locations in Dehradun and Udham Singh Nagar. False smut was prevalent across major paddy-growing regions, with disease intensity ranging from 0–15%. The highest incidence (up to 15%) was observed in Kotabagh and Motahaldu (Nainital district), while up to 10% incidence occurred in Dehradun, Gadarpur, Kashipur, and Khatima. Grain discolouration remained generally low, though 1–10% incidence was recorded in Pantnagar and Rudrapur. Associated mycoflora included *Curvularia, Fusarium, Helminthosporium, Aspergillus*, and *Penicillium* species. Mild incidences of panicle blight (up to 1%), bakanae (up to 5% in Basmati rice), brown spot (up to 10%), and sheath rot (0–10%) were also recorded across surveyed areas.

At DRPCAU, Pusa, a total of 101 unprocessed and 100 processed paddy seed samples representing multiple varieties were tested for bunt infection using the NaOH seed soak method, and none showed infection. Field surveys across 101 farmers' fields (22 locations) covering 10 varieties revealed bacterial leaf blight (BLB) incidence in 24% of samples, with severity ranging from 0-3 on a 0-9 scale. Higher BLB incidence was noted in hybrids, followed by varieties such as Rajendra Mahsuri, Rajendra Kasturi, Rajendra Bhagwati, Sugandha, and Swarna. In 20 seed production plots at Pusa and Dholi farms, BLB incidence was lower (16%) with severity ranging from 0-2. Bacterial panicle blight (BPB) was observed in 9 farmers' field samples and 5 seed production plots. False smut incidence was relatively higher, affecting 44% of farmers' fields and 36% of seed production plots, with severity ranging from 0-4. The

disease was prominent in hybrids and varieties like BPT 5204, Rajendra Sweta, Rajendra Bhagwati, Sugandha, and Swarna.

At OUAT, surveys indicated that major seed-borne diseases of rice viz., bacterial leaf blight (BLB), blast, brown spot, sheath rot, and false smut were prevalent at moderate levels across Odisha, while bunt incidence remained low. A total of 270 seed samples representing about 75 varieties were collected from eight districts and tested using the NaOH seed soak method, revealing bunt infection ranging from 0 to 0.35%. Although incidence was low, it was detected across all districts. Field surveys during the reproductive stage showed low to moderate false smut incidence, particularly in varieties Pooja and Sarala. Brown spot severity ranged from 2–4 (0–9 scale), while sheath rot incidence in seed production plots ranged from 1–3, with higher levels again in Sarala. Seed discolouration was associated with fungal pathogens such as *Curvularia, Fusarium, Penicillium*, and *Aspergillus* species.



**Teliospores of *Tilletia barclayana* in paddy (Bunt disease) at PJTSAU, Hyderabad**

At CSKHPKV, Palampur, surveys across districts of Himachal Pradesh revealed widespread occurrence of false smut (0–25%), brown spot (0–10%), and blast (0–5%), along with sheath rot and sheath blight in varying intensities. Notably, rice black streak dwarf virus incidence reached up to 30% in some areas. District-wise observations indicated high variability, with false smut reaching up to 50% in Sirmour and neck blast up to 50% in Kangra. Brown spot/narrow brown leaf spot showed severe incidence (up to 90–95%) in specific locations of Mandi. Grain discolouration was generally low to moderate across districts.

At ICAR NEH Region, Manipur, surveys covering 230 rice fields revealed significant prevalence of seed-borne diseases. Brown spot (9.5–15.55%), sheath rot (12.23–15.75%), and blast (5.55–10.25%) were prominent during vegetative stages, while false smut (30.25–41.00%) and grain discolouration (1.25–3.75%) dominated during later stages. The findings highlight the need for continuous monitoring and integrated disease management to safeguard rice productivity and seed quality.

At AAU, Anand, only 16 out of 168 seed samples (9.52%) showed bunt infection (0–0.5%), indicating low prevalence across Anand, Vadodara, and Kheda districts. False smut was recorded in 14.29% of fields (0–3 scale), while seed production plots remained disease-free. Grain discolouration occurred in 17.26% samples, associated with Fusarium, Aspergillus, and *Curvularia* species. No incidence of foot rot, BPB, brown spot, udbatta, or blast was observed. At PAU, Ludhiana, BLB was absent, but false smut (score 3–7) and grain discolouration (score 3–5) were widespread. Bakanae and bunt were also observed across districts, indicating

emerging concerns. At AAU, Jorhat, all samples were bunt-free. Brown spot (scale 2–7) was widely prevalent, while sheath rot, false smut, and grain discolouration occurred at low to moderate levels. At MPKV, Rahuri, bunt was absent, while false smut, BLB, grain discolouration, brown spot, udbatta, and blast were observed at low levels. At PAJANCOA&RI, Karaikal, grain discolouration was most prevalent, followed by brown spot, BLB, and blast, with varieties CO 51 and Improved White Ponni showing higher susceptibility. At TNAU, Coimbatore, all samples were bunt-free. BLB and brown spot were widespread, while false smut remained minimal and blast occurred at low levels. At RARS, Pattambhi, BLB showed highest severity (50%), followed by brown spot and false smut (30%). At SKUAST, Kashmir, neither bunt nor BLB incidence was recorded.




**False smut and BLB in paddy at farmers field at PAJANCOA&RI, Karaikal**

**Crop: Wheat**

At IARI, New Delhi, spot blotch incidence was low (3–5%, rating 1–3) in experimental fields, but higher (12–16%) in farmers' fields. Loose smut was <0.2% (below permissible limit), and no Karnal bunt was detected. At CSKHPKV, Palampur, loose smut incidence was negligible across districts. Common bunt was observed in Bilaspur, Sirmour, and Hamirpur. Loose smut ranged from 0-0.5% (Bilaspur), 0–0.2% (Hamirpur, Kangra), 0–0.01% (Sirmour), 0-0.4% (Una), 0.02% (Kullu), and 0-15% (Mandi). Common bunt ranged from 0-25% (Bilaspur), 0–17% (Mandi), 0–20% (Hamirpur), 0.22% (Kangra), 0-33% (Una), 0-15% (Kullu), and 0–13.8% (Sirmour). Fusarium head blight and black point were also noted.

At MPKV, Rahuri, 375 samples from Ahilyanagar, Nasik, and Pune showed no Karnal bunt, loose smut, or spot blotch. Head blight incidence ranged from 0.5–6.0%. At RARI, Durgapura, 100 samples from 41 villages showed 92% germination above IMSCS (85%). Karnal bunt was detected in 2 samples (0.01–0.6%). Loose smut (0.1–0.6%) occurred in 4 fields, and spot blotch was recorded in traces. No head blight or ear cockle was observed; *Alternaria* blight was minor. At GBPUAT, Pantnagar, loose smut was <0.5% (below permissible limit). Spot blotch incidence was ~10% (rating 1–5) across locations, reaching up to 20% at Pantnagar at maturity. At ANDUA&T, Ayodhya, Karnal bunt, loose smut, ear cockle, spot blotch, and head blight were recorded in traces. At PAU, Ludhiana, no incidence of spot blotch, head blight, or loose smut was recorded.




**Monitoring of wheat crop at farmers field at MPKV, Rahuri**

**Crop: Soybean**

At PJTSAU, Hyderabad, surveys in Adilabad, Nirmal, Nizamabad, and Sangareddy showed anthracnose at rating 1–3 (≤1% to 1–10% leaf area). Pod blight was at rating 1 (~1%). Purple seed stain ranged from rating 1–3 (1–30%) in Sangareddy and Nizamabad, and 1–2 (≤10%) in Nirmal and Adilabad. At RARI, Durgapura, 50 samples showed 94% germination (>70%). Incidence ranged 0.3–2.6% (purple stain), 0–3.3% (anthracnose), 0–2.3% (*Phomopsis* blight), <1% (downy mildew), with pod rot in traces. At JNKVV, Jabalpur, survey of 162 fields across seven districts recorded incidence of 0–3% (purple stain), 3–11% (pod blight), 2–11% (anthracnose), and 1–8% (YMV), with higher pod blight and anthracnose in Jabalpur and Narsinghpur.

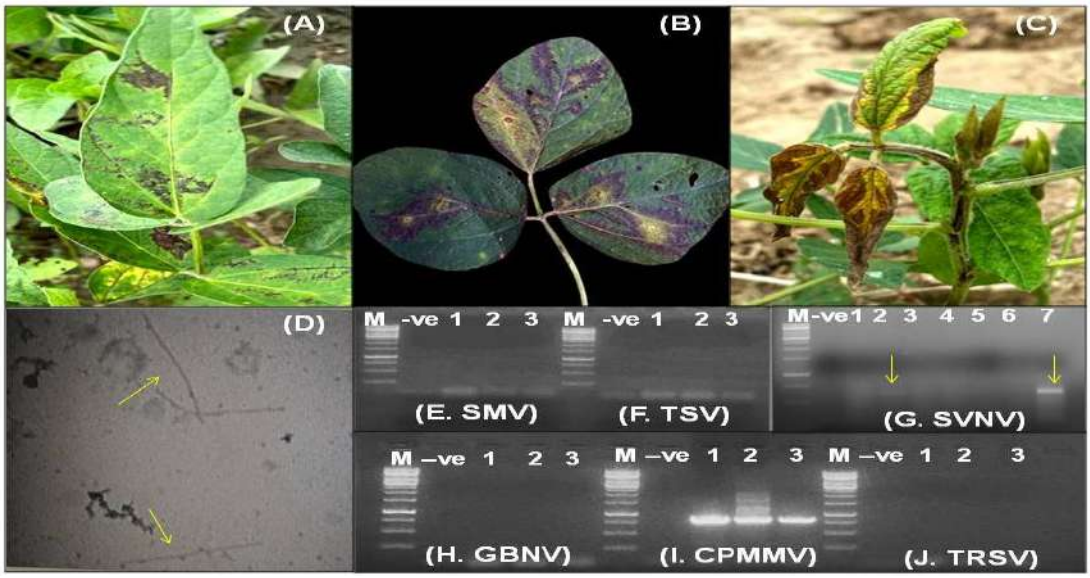
At MPKV, Rahuri, no downy mildew was observed in 650 fields. Other diseases ranged 0.5–3.0% (purple stain), 0.5–5.0% (pod blight), 0.5–4.0% (SMV, anthracnose), and 0.5–4.6% (YMV). At VNMKV, Parbhani, 107 samples showed low incidence: 0.96–6.97% (anthracnose), 0.60–8.75% (charcoal rot), 0.67–2.41% (pod blight), 0–9.54% (purple stain), and 0–12% (SMV). No new seed-borne pathogen was detected. At IARI, New Delhi, CPMMV was identified as the causal virus of soybean necrosis. TEM showed filamentous particles; DAC-ELISA and RT-PCR confirmed CPMMV (867 bp). The sequence (GenBank: PV692069) showed 99% similarity with an Indian urd bean isolate and 89–98% with other isolates, forming a distinct phylogenetic cluster.




**PJTSAU, Hyderabad- Incidence of pod blight at farmers field**




**Occurrence of different diseases of soybean in Madhya Pradesh by JNKVV, Jabalpur**




**ICAR-IARI, New Delhi: Field symptoms of necrosis and bud blight observed in soybean plants. A. Initial local necrosis B. Severe extended necrosis C. Terminal leaf and bud blight symptoms along with stem necrosis D. Flexuous virus particles under transmission electron microscope E & F. Absence of amplification with SMV and TSV specific primers G. Non-specific amplification with SVNV specific primers H & J. Absence of amplification with GBNV and TRSV specific primers I. Amplification of 867bp with CPMMV CP specific primers (From Sandra et al., 2025)**

**Crop: Groundnut**

At JNKVV, Jabalpur, a survey of 101 groundnut fields across three districts of Madhya Pradesh recorded collar rot (02–06%) and seed rot (02–03%). Incidence was highest in Chhindwara, followed by Seoni, and lowest in Jabalpur. At MPKV, Rahuri, 625 fields were surveyed, revealing collar rot (0.50–6.00%), stem rot (0.50–7.30%), seed rot (0.50–4.00%) and bud necrosis (0.50–3.00%). At OUAT, Bhubaneswar, 127 seed samples collected during May–June 2025 from Khurda, Ganjam, Dhenkanal and Bargarh districts, covering six varieties, showed germination of 15–80%. Seed rot ranged from 1–12%, collar rot from 1–14% and stem rot from 1–21%. Field observations also confirmed stem rot occurrence.

At RARI, Durgapura, 100 samples from four Rajasthan districts showed germination above 70%, with seed rot incidence of 0.3–1.33% and collar rot of 1.0–5.0%. At TNAU, Coimbatore, 200 fields across four districts in Tamil Nadu recorded collar rot in all major varieties. Incidence ranged from 6.44–16.80%, with the highest in Cuddalore (16.80% in farmers' fields and 11.00% in seed plots) and lowest in Tirupathur (6.44% and 3.50%, respectively). At AAU, Anand, 154 samples from four districts (10 varieties) showed 100% prevalence of Aspergillus seed rot. Predominant species were *A. niger* (0–14%) and *A. flavus* (0–10%).



**Incidence of collar rot disease in groundnut at farmers field recorded by different centres**



**Association of A. niger and A. flavus in groundnut at AAU, Anand**

**Crop: Potato**

At SKUAST, Srinagar, findings showed, potato in Kashmir is increasingly affected by virus-like symptoms. Earlier research trials confirmed the presence of Potato leaf roll virus (PLRV) as an emerging threat. To assess its spread, samples were collected across the Kashmir valley and analyzed, confirming PLRV presence in multiple locations.




**Wet lab confirmation of PLRV from samples showing mosaic, puckering of leaves and stunted growth**

**Crop: Chickpea**

At IARI, New Delhi, 62 chickpea fields across Baraut, Meerut, Noida, Ghaziabad and Gurgaon showed wilt incidence of 3–10%. No grey mould or *Ascochyta* blight was observed. At MPKV, Rahuri, 625 fields were surveyed with no incidence of *Ascochyta* blight, grey mould or *Stemphylium* blight. Wilt ranged from 1.0–13.0%, while dry rot and wet rot were 1.0–6.0% and 1.0–2.0%, respectively. At RARI, Durgapura, 75 samples from major varieties showed >75% germination in 71 samples, while 4 had <75%. Wilt incidence ranged from 0.5–12.5% across 30 fields. No grey mould or *Ascochyta* blight was detected. At JNKVV, Jabalpur, a survey of 111 plots recorded collar rot (06–19%), wilt (05–13%), dry root rot (03–09%) and grey mould (0–3%). Collar rot was highest in Panagar and Patan, while wilt was highest in Jabalpur and Katni.



**Collar rot** **Wilt** **Dry root rot**

**Association of different diseases with chickpea at JNKVV, Jabalpur**

**Crop: Ragi/ Finger millet**

At JNKVV, Jabalpur, a survey of 65 finger millet fields in Rewa and Dindori recorded blast (leaf, neck and finger) and *Helminthosporium* leaf spot with incidences of 06–12%, 07–16% and 09–17%, respectively. Disease incidence was highest in Dindori, while Rewa showed lower blast levels and no *Helminthosporium* leaf spot, indicating clear regional variation.



**Leaf blast** **Neck blast** **Finger blast**

**Symptoms of different types of finger millet blast at farmer's field at TNAU, Coimbatore**

At MPKV, Rahuri, 221 fields across Ahilyanagar, Nashik, Pune, Kolhapur and Satara recorded leaf blast (0.5–9.00%), neck blast (0.50–2.00%), finger blast (0.10–0.50%), downy mildew (0.10–3.00%) and leaf blight (0.50–2.00%). At TNAU, Coimbatore, surveys in five districts (Krishnagiri, Dharmapuri, Salem, Thiruvannamalai and Villupuram) during 2025–26

showed blast incidence in all major varieties in all districts surveyed except Villupuram. Leaf blast ranged from grade 1–5, while neck and finger blast ranged from 0.00–15.40% and 0.00–18.20%, respectively. At PJTSAU, Hyderabad, surveys in Mahabubnagar, Ranga Reddy and Vikarabad indicated very low blast incidence (rating 1–2), corresponding to <1–5% leaf area affected, mainly in Mahabubnagar.

❖ **Experiment 2: Studies on seed health status of farmers saved seeds.**

**Crop: Rice**

At ICAR NEHR, Manipur, farmers' saved seeds from five districts (Imphal East, Imphal West, Kakching, Thoubal and Bishnupur) representing 13 varieties were analysed. Germination ranged widely from 1% to 98.5%, with ~85 samples showing high germination (>80%), while 83 samples had moderate to low viability, including one non-viable sample. Disease incidence varied from 0–17%, with higher infection in RCM-13, Thangjing and RC-Manichakhao-1, and lowest in Ayangleima. False smut (44.52%) and dirty panicles (34.26%) were prominent. Fungal pathogens such as *Alternaria*, *Rhizopus*, *Aspergillus*, *Curvularia* and *Fusarium* were detected, indicating inconsistent seed health.

**Detection of seed-borne pathogens associated with discoloured paddy seeds by blotter method at ICAR-IARI, New Delhi**



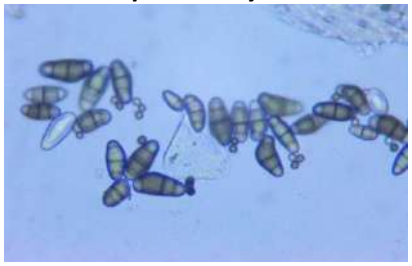
**Growth of different seed-borne fungi on rice seeds**



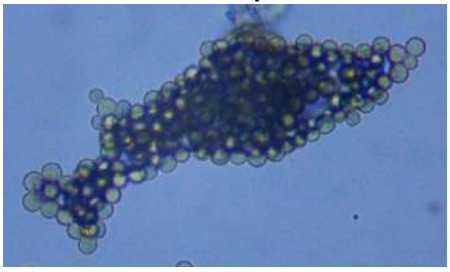
***Bipolaris oryzae***



***Trichoconiella padwickii***



***Curvularia lunata***



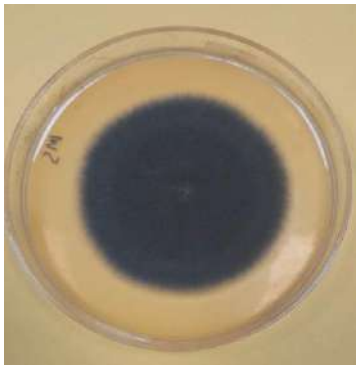
***Aspergillus oryzae***

At IARI, New Delhi, 153 samples from Ghaziabad, Noida, Gurgaon and Meerut showed germination of 82–89% and low mycoflora (0–1.5%). No bunt incidence or sub-standard germination (<80%) was observed, though grain discolouration ranged from 7–16%. At PAJANCOA&RI, Karaikal, 153 samples from Puducherry and Karaikal showed moisture content of 10–15.2%, with 71.9% samples above 13%. Germination ranged from 0–93%, and only 19.6% met IMSCS standards. Seed discolouration varied widely (2–88%), highest in CR1009 and Maguri land races. Infection ranged from 4.0–97.3%, with highest in Gumsali (97.3%) and Mapillai samba (86.7%), especially in gunny bag storage. Predominant fungi were *Helminthosporium* spp. and Aspergillus flavus, with storage method influencing infection levels.

At CSKHPKV, Palampur, significant incidence of false smut and brown spot was recorded across districts viz., Hamirpur (33.33% and 25.08%), Kangra (30.77% and 17.31%), Mandi (33.33% and 29.63%), Chamba (15.38% and 7.69%), Una (50% and 20%) and Sirmour (45% and 47.5%). At MPKV, Rahuri, 440 samples showed germination of 62–93% and mycoflora of 0.5–9.3%. About 10.9% samples had discoloured seed infection, while 25 samples recorded germination below IMSCS (<80%). No bunt infection was observed. At TNAU, Coimbatore, 115 samples from 10 districts showed germination of 60–95%, with 5.22% below IMSCS. No bunt incidence was recorded. Seed discolouration ranged from 0–35%, with pathogens including *Bipolaris, Fusarium, Curvularia, Aspergillus* and *Rhizopus*.



**Growth of seed borne pathogens on blotter paper technique**



***Curvularia sp*. isolated from paddy sample.**



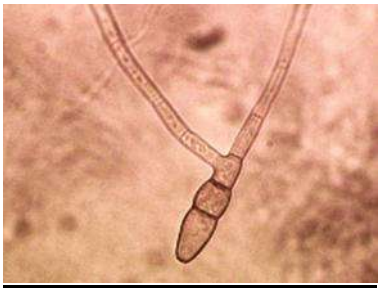
***Fusarium sp*. isolated from paddy sample.**

**Detection seed borne diseases in farm saved seeds of paddy at OUAT, Bhubaneswar**

At AAU, Jorhat, 110 samples showed germination of 76–89%, with 12.72% below IMSCS. Moisture ranged from 9.8–14.5%. No bunt was detected, but seed discolouration and pathogens such as *Aspergillus, Bipolaris, Curvularia* and *Rhizopus* were observed. At AAU, Anand, 146 samples from seven districts showed germination of 80–95%. Seed discolouration ranged from 2-12%, and seed/seedling rot ranged from 0–8% and 0–7%. Fungal association included *Fusarium, Curvularia* and *Aspergillus*. At PAU, Ludhiana, 1592 samples from 16 districts showed widespread bunt infection (>90% samples), with maximum incidence of 2.35% in PUSA 44 (Barnala) and 2.25% in PR 126 (Amritsar). At DRPCAU, Pusa, 101 samples from two locations showed no bunt infection, though grain discolouration ranged from 10–

18%. Pathogens included *Aspergillus, Penicillium, Bipolaris, Curvularia, Sarocladium, Ustilaginoidea* and *Burkholderia*.

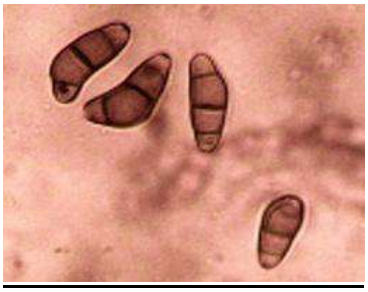
At SKUAST, Srinagar, all samples had germination above IMSCS, with seed discolouration of 10–20%. Common pathogens included *Bipolaris* oryzae, *Alternaria* spp., *Pyricularia oryzae* and *Fusarium fujikuroi*. At PJTSAU, Hyderabad, 262 samples from 10 districts recorded >80% germination, highest in Medak (93.75%). Mycoflora included *Helminthosporium*, *Fusarium* (1.14%) and *Aspergillus* (1.08%) among others. At OUAT, Bhubaneswar, 270 samples from eight districts showed low bunt incidence (0–0.35%), though present across all districts. Discolouration-associated fungi included *Curvularia* (1–6%), *Fusarium* (1–6%), *Penicillium* (1–8%) and *Aspergillus* (1–12%). At RARS, Pattambi, 60 samples showed germination of 57.75–96%, with 21.66% below IMSCS. Moisture ranged from 11.2–13.8%, with 28% samples above 13%. Discolouration ranged from 1–19%, infection from 1–12%, and seedling rot from 1–6%. Associated fungi included *Aspergillus, Alternaria, Bipolaris, Curvularia, Fusarium* and *Ustilaginoidea*.



***Alternaria* sp.**



***Aspergillus* sp.**



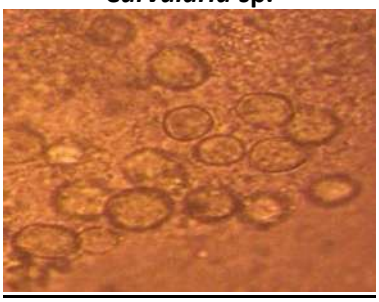
***Curvularia* sp.**



***Fusarium* sp.**



***Cercospora* sp.**



***Ustilaginoidea virens***

**Detection of seed borne diseases in paddy farm saved seeds at KAU, Pattambi**

**Crop: Wheat**

At PAU, Ludhiana, the maximum incidence of Karnal bunt in farmer-saved wheat seed samples during 2024–25 was low, recorded at 0.28% in Amritsar, 0.25% in Sangrur and Malerkotla, and 0.23% in Barnala. At RARI, Durgapura, wheat seeds collected from 90 villages across Jaipur, Dausa, and Sikar districts were evaluated for germination and seed health. About 93.33% of samples exhibited germination above IMSCS standards. *Tilletia indica* was detected in four samples, with a maximum Karnal bunt incidence of 0.15% in Ramgarh village (Dausa). However, all infections remained below IMSCS limits. Associated mycoflora included *Alternaria, Aspergillus, Curvularia,* and *Fusarium*.

At MPKV, Rahuri, 566 wheat samples from Nasik, Ahilyanagar, and Pune districts showed germination ranging from 71–98%, while seed mycoflora ranged from 1.0–9.7%.

Fifteen samples recorded germination below MSCS (85%). At CSKHPKV, Palampur, farmer-saved seeds from multiple districts of Himachal Pradesh revealed Fusarium head blight (0–45%) and black point disease (0–40%), particularly in Hamirpur. Predominant fungi identified through agar plate and blotter methods included *Fusarium, Bipolaris, Alternaria alternata, Curvularia lunata, Aspergillus niger, Trichoderma, Rhizopus stolonifer,* and *Tilletia* spp.

At GBPUAT, Pantnagar, 204 samples from six districts showed germination between 85–92%, all above IMSCS levels. *Tilletia indica* was detected in four samples (two each from Dehradun and US Nagar), with a maximum Karnal bunt incidence of 0.25% in Dehradun. All infections were below IMSCS limits, and no loose smut was detected. Mycoflora included *Alternaria, Aspergillus, Curvularia, Fusarium,* and *Helminthosporium*. At DRPCAU, Pusa, 104 samples (germination 80–91%) from Bihar showed no incidence of loose smut, Karnal bunt, or ear cockle. Common fungi included *Aspergillus, Penicillium,* and *Alternaria triticiana*, with grain discoloration ranging from 4–8%.

**Crop: Soybean**

At JNKVV, Jabalpur, laboratory analysis of 162 farmers' saved soybean seed samples from seven districts of Madhya Pradesh revealed the presence of major seed-borne fungi, including *Macrophomina phaseolina* (01–08%), *Colletotrichum truncatum* (01–07%), *Fusarium oxysporum* (01–10%), and *Aspergillus flavus* (01–05%). The highest pathogen incidence was observed in Jabalpur, with seed germination ranging from 76–89%, indicating variability in seed health across locations. At PJTSAU, Hyderabad, 122 soybean seed samples from Adilabad, Nirmal, Nizamabad, and Sangareddy districts were evaluated using paper towel and blotter methods. Germination ranged from a minimum of 68.49% in Nizamabad (below IMSCS) to a maximum of 78.24% in Adilabad. Seed mycoflora included *Macrophomina, Colletotrichum, Fusarium, Alternaria,* and *Diaporthe/Phomopsis*. The highest incidence was recorded for *Fusarium* spp. (5.35%), followed by *Macrophomina* (4.91%) and *Diaporthe/Phomopsis* (4.71%). *Diaporthe/Phomopsis* was detected in all samples, with maximum incidence (6.59%) in Sangareddy. *Colletotrichum* showed 10.86% recovery, while *Aspergillus* spp. (1.71%) represented storage fungi. Purple seed stain ranged from 1.86–3.86%.

At MPKV, Rahuri, 642 soybean samples from eight districts showed germination ranging from 45–88%, with seed mycoflora between 0.5-7.44%. A total of 55 samples had germination below the minimum seed certification standard. At RARI, Durgapura, soybean seeds from Kota–Jhalawar and Udaipur regions showed that 94% of samples had germination above IMSCS. Pathogen incidence included *Colletotrichum* (0.01–2.6% in 23 samples), *Macrophomina phaseolina* (0.2–0.5% in 12 samples), and *Cercospora* (0.03–2.6%). Trace infection (<1%) of *Fusarium* and 1–2% of *Diaporthe* were also observed. At VNMKV, Parbhani, 105 samples across eight districts showed incidence of major diseases: soybean mosaic virus (1.0–12.4%), purple stain (0.0–9.1%), anthracnose (0.0–7.2%), charcoal rot (0.0–10.3%), pod blight (*Phoma medicaginis*) (0.0–5.1%), *Fusarium oxysporum* (0.0–6.2%), and *Alternaria alternata* (0.0–5.5%). Germination below MSCS (70%) was observed in 18.22% of samples.

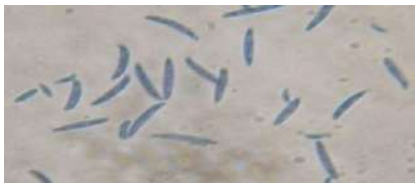


**SMV**



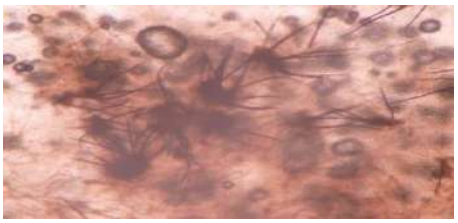
***C.kikuchii***





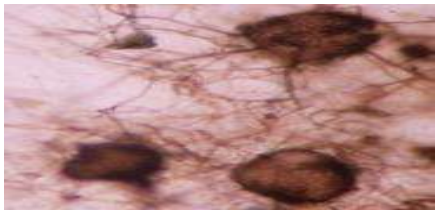
***Fusarium oxysporum***





***Colletotrichum truncatum***





***Macrophominaphaseolina***





***Alternaria alternata***

**Seed Borne mycoflora associated with farmers own saved seeds of Soybean at MPKV, Rahuri**

**Crop: Groundnut**

At JNKVV, Jabalpur, analysis of 87 farmers' saved groundnut seed samples from three districts of Madhya Pradesh revealed seed infection ranging from 11–15%, with *Aspergillus flavus* (01–09%) and *A. niger* (01–02%) as major pathogens. The highest infection was observed in Seoni, followed by Chhindwara. Germination ranged from 74–82%, with 6 samples below IMSCS standards. At AAU, Anand, 159 samples from Junagadh, Rajkot, Surendranagar, and Jamnagar districts showed germination between 80–95%. All samples were infected with *Aspergillus* seed rot (2-10%), predominantly *A. niger* and *A. flavus*. Certified varieties GJG 32 and GG 20 recorded higher germination (85-95%) and lower seed rot (3–9%) compared to farmers' saved seeds.

At MPKV, Rahuri, 402 samples from seven districts showed germination up to 52.89% and seed mycoflora ranging from 1.0–14.7%. Thirty-seven samples had germination below MSCS (70%). Most samples were infected with *A. niger* and *A. flavus*. At OUAT, Bhubaneswar, 127 samples collected from four districts of Odisha showed wide variability, with germination ranging from 15–80%. Seed rot ranged from 1–12%, collar rot 1–14%, and stem rot 1–21% across varieties. At TNAU, Coimbatore, 105 samples from five districts showed that 6.67% samples had germination below IMSCS (70%). All samples were infected with *Aspergillus* seed rot. Infection levels were highest for *A. flavus* (3.84–31.50%), followed by *A. niger* (0.00–19.90%), *Sclerotium* (0.00–3.80%), and *Rhizopus* (0.00–6.45%). At RARI, Durgapura, 90 samples from four districts showed 94.4% samples above IMSCS germination. *Aspergillus* infection was observed in 53.33% samples, with incidence ranging from 5–15%.

**Crop: Chickpea**

At IARI, New Delhi, 53 farmers' saved chickpea seed samples from Meerut, Noida, Ghaziabad, and Gurgaon were evaluated for germination and seed mycoflora. All samples recorded germination above IMSCS levels. Only *Fusarium* sp. was detected, with incidence ranging from 0.2–4.6%. At RARI, Durgapura, chickpea seeds collected from 65 villages across Jaipur, Dausa, and Sikar districts showed that 61 out of 65 samples had germination above IMSCS standards. Seed rot was observed in 22 samples, with infection levels ranging from 0.5–7.0%. Associated fungi included *Aspergillus flavus, Fusarium, Macrophomina, Stemphylium,* and *Cladosporium*. At MPKV, Rahuri, 608 chickpea seed samples from Pune, Ahmednagar, Nasik, Nandurbar, Sangli, Satara, and Solapur districts were analyzed. Germination ranged from 64–97%, while seed mycoflora varied between 1.0–11.7%. A total of 29 samples recorded germination below the minimum seed certification standard (85%). At JNKVV, Jabalpur, analysis of 117 farmers' saved chickpea seed samples from three districts of Madhya Pradesh revealed the presence of *Fusarium oxysporum* (01–06%), *Botrytis cinerea* (01–02%), and *Aspergillus flavus* (01–05%). The highest pathogen incidence was recorded in Rewa. Germination ranged from 81–90%, with 10 samples falling below IMSCS standards. *Ascochyta rabiei* was not detected in any sample.

**Crop: Ragi/Finger millet**

At JNKVV, Jabalpur, analysis of 111 farmers' saved finger millet seed samples from three districts of Madhya Pradesh revealed seed infection ranging from 11–16%, with *Alternaria alternata* (01–04%), *Aspergillus flavus* (01–13%), and *A. niger* (01–05%) as major pathogens. The highest infection was observed in Mandla, followed by Dindori. Germination ranged from 80–88%, with 6 samples below IMSCS standards. At TNAU, Coimbatore, 106 samples collected from five major districts of Tamil Nadu showed that 3.77% of samples failed to meet the minimum germination standard (75%). Blotter test results indicated the presence of *Alternaria, Curvularia,* and *Aspergillus*, with infection ranges of 0.0–4.10%, 0.0–6.82%, and 0.0–7.25%, respectively. At Hyderabad (covering Mahabubnagar, Ranga Reddy, and Vikarabad districts of Telangana), 52 samples recorded high germination ranging from 90.67–

92.22%. Seed-borne fungi detected included *Curvularia, Alternaria, Fusarium,* and *Aspergillus*. Among these, *Fusarium* sp. was predominant (5.24%), followed by *Curvularia* sp. (0.70%). Storage fungi (*Aspergillus*) incidence was low (0.56%). At MPKV, Rahuri, 262 finger millet samples from five districts showed germination ranging from 54–93%, with seed mycoflora between 0.5–7.7%. A total of 16 samples recorded germination below IMSCS (75%).

❖ **Experiment 3: Standardization of detection methods for seed-borne pathogens of significance.**

**Crop: Mustard**

At JNKVV, Jabalpur, evaluation of detection methods for seed-borne mycoflora in mustard showed that the Host Agar Media method was most efficient, recording higher incidences of *Alternaria brassicae* (29%), *A. alternata* (12%), *Fusarium oxysporum* (9%) and *Macrophomina phaseolina* (7%), along with lower levels of *Aspergillus flavus* (3%) and *A. niger* (1%). In contrast, the NaOH dipped blotter method showed very low detection (1–2%) for all pathogens, indicating poor sensitivity.

At TNAU, Coimbatore, four seed health testing methods were compared, and the mustard seed extract method recorded the highest frequency of *Alternaria* (7.80%), followed by the alkali blotter method (4.75%). Similarly, at MPKV, Rahuri, Host Agar media detected higher numbers of *Alternaria brassicae* (52%) and *A. alternata* (20%), along with *Fusarium oxysporum* (12%) and *Macrophomina phaseolina* (9%), whereas the NaOH dipped blotter method was less effective.

At AAU, Jorhat, maximum recovery of *Alternaria* spp. was observed in the Seed Extract Agar Method (Modified Agar Plate) (13%), followed by NaOH 0.2% (6.4%). At PJTSAU, Hyderabad, the same method recorded the highest recovery (1.38%), followed by the 2,4-D blotter method (1.05%). At GBPUAT, Pantnagar, the seed extraction method showed higher recovery of *Alternaria* (28.2%), followed by the NaOH blotter method (25.75%), with earlier detection noted in the former, though accompanied by higher levels of other mycoflora.



**Standard blotter method**



**Agar plate methods**



Host leaf extract method



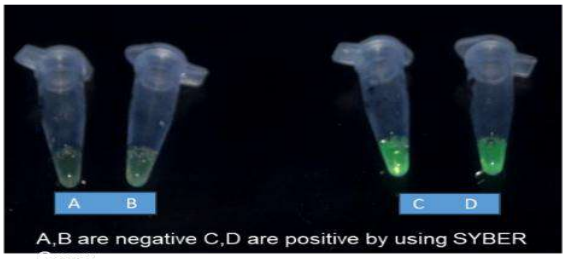
NaOH blotter soak method

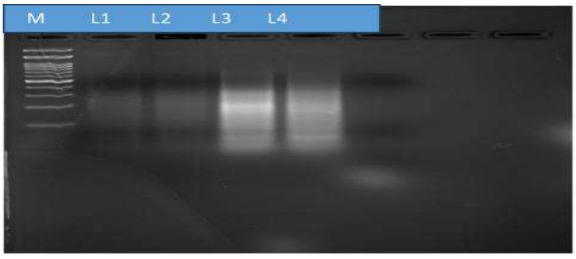
**Standardization of detection technique Alternaria spp. in Mustard at PJTSAU, Hyderabad**

At PAU, Ludhiana, maximum pathogen recovery was achieved using the agar plate method. Similarly, at IARI, New Delhi, the mustard seed extract method recorded the highest frequency of *Alternaria* spp., followed by the alkali blotter method. Overall, agar-based and seed extract methods proved more effective than blotter-based methods for detecting seed-borne pathogens in mustard.

**Crop: Beans**

At SKUAST–Srinagar, an RT-LAMP assay was optimized for detection of Bean Common Mosaic Virus (BCMV) under specific reaction conditions, enabling efficient amplification of viral RNA at a constant temperature and eliminating the need for thermal cycling required in conventional PCR. The method significantly reduced detection time while maintaining high specificity and sensitivity, allowing early and accurate identification of BCMV in plant samples. The standardized RT-LAMP protocol also enabled detection of low concentrations of viral RNA, making it suitable for field-level diagnostics and routine screening. Its simplicity, rapid turnaround, and minimal equipment requirements support large-scale surveillance and management of BCMV in bean crops. Additionally, a field-deployable detection method integrating RT-RPA, CRISPR Cas12a, and lateral flow assay was developed. The CRISPR Cas12a-based assay was 1000 times more sensitive and highly specific compared to RT-PCR. The sample-to-answer time was reduced from 1–2 days to 60–75 minutes. To enhance field applicability, the assay was optimized at 37 °C, and results can be interpreted with the naked eye. Moreover, it enables direct detection of BCMV from crude plant sap with high sensitivity and specificity, making it a robust tool for rapid, on-site diagnostics.

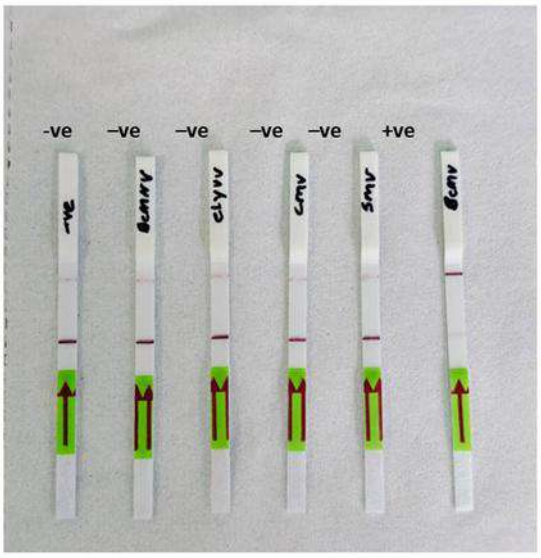



**RT- LAMP (loop-mediated isothermal amplification ) Based Detection of BCMV**




**Optimization of RT-RPA coupled CRISPR Cas12a assay**




**Sensitivity of RT-RPA coupled CRISPR Cas12a assay for BCMV**

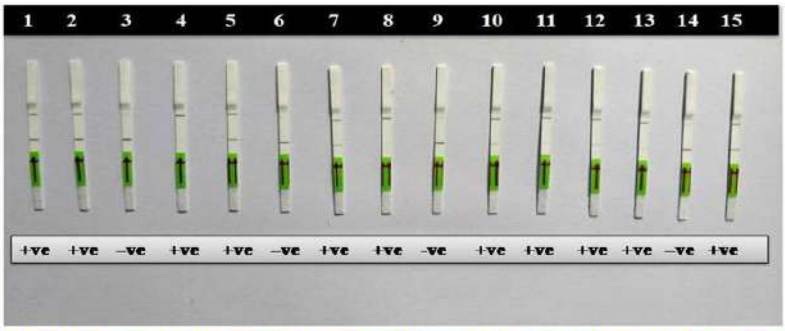
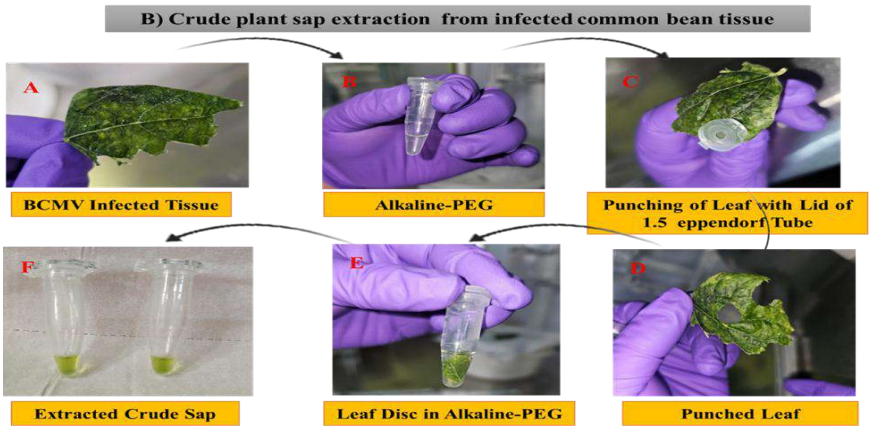



**Fig. Direct detection of BCMV from crude plant extract using RT-RPA coupled *Lb*CRISPR-Cas 12a based LFA**




**Development of detection method for seed borne viruses in beans at SKUAST, Srinagar**

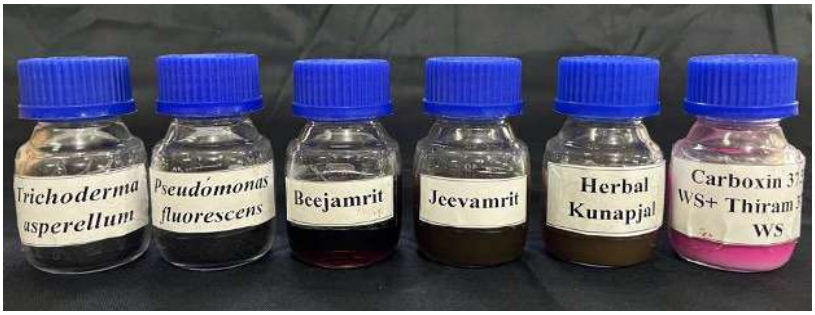



**On-spot CRISPR based diagnostic Kit for BCMV developed by SKUAST, Srinagar**

- **Experiment 4: Development of eco-friendly low-cost input / indigenous technology for the production of disease-free soybean, chickpea and groundnut seeds.**

**Crop: Soybean**

At VNMKV, Parbhani, all treatments with biocontrol agents and organic products (seed treatment + foliar spray) significantly improved field emergence, reduced seedling mortality, and enhanced shoot length, root length, and dry matter over control. Treatment T6 (*T. asperellum* ST @10 ml/kg seed in 100 ml water + foliar spray at 30, 45, and 60 DAS) recorded 93.00–93.33% field emergence, minimum seedling mortality of 7.00%, 12.33%, 14.0%, and 15.0% at 15, 30, 45, and 60 DAS, and the highest shoot length (30.33 cm), root length (15.35 cm), and dry weight (5.83 g/plant) at 45 DAS. It was followed by T10 (Herbal Kunapjal ST + foliar spray), which showed 90.33% emergence; seedling mortality of 4.66%, 15.66%, 16.66%, and 18.66%; and shoot length (28.96 cm), root length (14.33 cm), and dry weight (4.93 g/plant) at 45 DAS.




**Different Formulations used for seed treatment in soybean**



**Soybean seeds treated with respected formulation**




**View of pot experiment for evaluation of Effect of bioagents and organic products on seed quality parameters of Soybean seed inoculated with *Macrophomina phaseolina* at JNKVV, Jabalpur**

At JNKVV, Jabalpur, organic and biological formulations improved soybean germination, growth, and resistance to *Macrophomina phaseolina*. Seed treatment + soil drenching with *Trichoderma asperellum* @10 g/kg seed at 15, 30, and 45 DAS was most effective, reducing disease by 69.28% and enhancing growth and biomass. Beejamrit and Herbal Kunapjal were the next best treatments. At GBPUAT, Pantnagar, seed treatment + soil drenching with *T. asperellum* @10 g/kg seed (30, 45, 60 DAS) effectively reduced *M. phaseolina* incidence and improved shoot length, root length, and dry matter. Herbal Kunapjal and Beejamrit also enhanced emergence and growth under similar application.

At MPKV, Rahuri, seed treatment + soil drenching with *T. asperellum* @10 g/kg seed at 15, 30, and 45 DAS reduced *M. phaseolina* by 66.09% and increased field emergence, shoot length, root length, and dry matter by 30.30%, 90.88%, 53.64%, and 51.60%, respectively. Beejamrit followed, reducing disease by 63.39% and improving these traits by 24.24%, 82.96%, 50.77%, and 46.80%. At AAU, Jorhat, no disease symptoms were observed, including in control plots. However, *T. asperellum* seed treatment recorded the highest field emergence (84.33%), followed by Herbal Kunapjal (83.67%). Both also improved shoot length, root length, and dry weight when combined with soil drenching at 15 DAS.

**Crop: Chickpea**

At JNKVV, Jabalpur, organic and biological formulations improved soybean germination, growth, and resistance to *Macrophomina phaseolina*. Seed treatment + soil drenching with *Trichoderma asperellum* @10 g/kg seed at 15, 30, and 45 DAS was most effective, reducing disease by 69.28% and enhancing growth and biomass. Beejamrit and Herbal Kunapjal were the next best treatments.

At RARI, Durgapura, all treatments improved germination of seeds inoculated with *Fusarium oxysporum* and *Rhizoctonia bataticola* over control. While the chemical check was most effective, among bio-treatments, seed treatment + soil drenching of *T. asperellum* (15, 30, 45 DAS) was superior, recording least wilt (3.46%) and DRR (2.75%) with better growth.

*Pseudomonas fluorescens* showed similar trends, and both treatments were statistically at par for growth at 30 DAS.

At AAU, Anand, all treatments improved growth, vigor, and reduced stem rot over control in chickpea. The chemical check (Carboxin + Thiram) was best, recording highest shoot (44.90 cm), root (12.60 cm), seedling length (57.50 cm), dry weight (8.97 g/plant), vigor (SVI-I: 4158.14; SVI-II: 1280.71), and lowest disease incidence (12.72% and 6.01%). Among bioagents, *T. asperellum* (seed treatment + soil drenching) was most effective with 97.87% emergence, high vigor (SVI-I: 3958.39; SVI-II: 1202.78), and reduced disease (16.47% and 9.07%), followed by Herbal Kunapjal. Control recorded the lowest growth and highest disease (26.46% and 15.08%).

At MPKV, Rahuri, in chickpea, seed treatment + soil drenching of *T. asperellum* @10 g/kg seed (15, 30, 45 DAS) reduced *F. oxysporum* and *R. bataticola* by 69.73% and 70.91%, and increased field emergence, shoot length, root length, and dry matter by 73.47%, 24.59%, 24.34%, 100.00% and 50.55%, 32.47%, 27.02%, 97.30%, respectively. Beejamrit followed with reductions of 68.06% and 68.94%, and improvements of 69.39%, 16.85%, 15.93%, 85.99% and 47.15%, 25.00%, 19.88%, 89.19%, respectively.

At GBPUAT, Pantnagar, seed treatment + soil drenching of *T. asperellum* @10 g/kg seed (30, 45, 60 DAS) effectively reduced Fusarium wilt and Rhizoctonia rot and improved growth and dry matter. Herbal Kunapjal and Beejamrit also enhanced emergence and growth. At ANDUAT, Ayodhya, observations on germination, seedling mortality, and disease incidence are being recorded at 15, 30, 45, and 60 DAS, while growth parameters are assessed at 30 DAS under controlled conditions.

**Crop: Groundnut**

At AAU, Anand, all treatments significantly improved seedling growth, vigor, and reduced stem rot (*Aspergillus flavus*, *Sclerotium rolfsii*) over control. The chemical check (Carboxin + Thiram) performed best with 98.72% emergence, highest vigor (SVI-I: 3398.30; SVI-II: 1491.75), and lowest disease incidence (1.87% and 0.16%). Among bioagents, *Trichoderma asperellum* (seed treatment + soil drenching) was most effective with 98.48% emergence, high vigor (SVI-I: 3178.83; SVI-II: 1445.38), and reduced disease (2.52% and 0.41%), followed by Herbal Kunapjal. Control recorded lowest growth and highest disease (7.82% and 3.59%). At OUAT, Bhubaneswar, highest field emergence at 15 DAS was recorded in Pseudomonas (82.64%, transformed 65.39) and Beejamrit (80.00%, 60.00) seed + soil treatments. Pseudomonas gave maximum shoot length (14.63 cm) and dry weight (2.22 g) at 30 DAS. Disease incidence was lowest in Pseudomonas (12.13%, 20.33) and Beejamrit (12.51%, 20.39), indicating effective control; treatment effects were statistically significant.

At RARI, Durgapura, all treatments reduced collar rot and improved growth over control. Excluding chemical check, *T. asperellum* (ST+SD) was most effective with lowest disease incidence (5.12%), statistically at par with *Pseudomonas fluorescens* (6.11%). Both also improved root length, shoot length, and dry weight. Among organics, Beejamrit performed best, followed by Jeevamrit and Kunapajala; ST+SD was superior to ST alone. At

MPKV, Rahuri, in groundnut, seed treatment + soil drenching of *T. asperellum* @10 g/kg seed (15, 30, 45 DAS) reduced *Sclerotium rolfsii* and *Aspergillus flavus* by 57.52% and 75.66%, and increased field emergence, shoot length, root length, and dry matter by 44.26%, 30.45%, 29.21%, 113.46% and 45.45%, 26.88%, 34.76%, 83.51%, respectively. Beejamrit followed with reductions of 53.60% and 75.39%, and improvements of 39.34%, 21.99%, 19.51%, 93.59% and 41.82%, 15.66%, 24.52%, 71.81%, respectively.

❖ **Experiment 5: Development of seed health standards for important seed-borne diseases.**

**Chilli: Alternaria Blight**

At MPKV, Rahuri and JNKVV, Jabalpur, studies established the seed health standard for foundation seed in chilli based on maximum permissible infection of *Alternaria alternata* at 0.1%. The results from both centres clearly demonstrated that even a marginal increase in infected seed proportion leads to a sharp rise in pathogen incidence in both standing crop and harvested seeds, justifying the proposed threshold.

At MPKV, Rahuri, the control treatment (1000 seeds without inoculation) recorded no seed infection (0.0%), although field incidence of *A. alternata* was 0.80% and infection in harvested seeds was 0.2%. When one inoculated seed was introduced (999 + 1; 0.1%), seed infection reached 0.1%, with blotter incidence at 0.6% and infection in harvested seeds increasing to 0.4%. With two inoculated seeds (998 + 2; 0.2%), infection increased to 0.2%, field/blotter incidence rose to 1.8%, and harvested seed infection sharply increased to 10.0%. These findings highlight that even minimal increases in initial infection significantly amplify disease spread, supporting the 0.1% seed health standard.

At JNKVV, Jabalpur, a similar trend was observed. In the control (1000 seeds), seed infection was 0.0%, while field and harvested seed incidence were 0.50% and 0.1%, respectively. At 0.1% infection (999 + 1) (disease free seed + infected seed), blotter incidence was 0.4% and harvested seed infection was 0.3%. Increasing infection to 0.2% (998 + 2) resulted in 1.9% blotter incidence and 9.1% infection in harvested seeds. Further increase to 0.5% infection (995 + 5) caused a substantial rise in pathogen incidence, reaching 4.9% in blotter tests and 28.1% in harvested seeds. These results reaffirm that small increases in infected seed proportion can drastically enhance disease incidence, validating the 0.1% threshold for foundation seeds. The treatments evaluated were T1 (1000 + 0), T2 (999 + 1), T3 (998 + 2), and T4 (995 + 5 inoculated seeds).

At PJTSAU, Hyderabad, studies on artificially inoculated chilli seeds further supported these observations. Seeds with higher infection levels showed a marked increase in seed infection (53.25%) along with a significant reduction in germination (48.88%) under paper towel testing. In contrast, seeds with lower infection levels showed minimal impact, with only 7.19% infection and no major reduction in germination. This indicates that higher pathogen load adversely affects both seed health and viability.

At GBPUAT, Pantnagar, recovery of *Alternaria* from chilli seeds at different inoculum levels (0, 0.1, 0.2, and 0.5%) was recorded at 5.5%, 30.75%, 45.5%, and 54.5%, respectively. The study also indicated that apparently healthy seeds may carry latent or symptomless infection, contributing to higher pathogen recovery even at low infection levels. Overall, the findings across centres consistently demonstrate that even low levels of seed infection can lead to significant disease escalation. Therefore, maintaining a stringent seed health standard of 0.1% infection is critical for preventing disease spread and ensuring quality seed production. Further validation of these results is proposed at IARI, New Delhi and PAU, Ludhiana in the coming year.

**Development of seed health standards for *Alternaria* blight in chilli**



**$T_1$ - 1000 Foundation seeds + 00 Inoculated seed with *A. alternata***



**$T_2$ - 999 Foundation seeds + 01 Inoculated seed with *A. alternata***



**T3 - 998 Foundation seeds + 02 Inoculated seed with *A. alternata***



**T4- 995 Foundation seeds + 05 Inoculated seed with *A. alternata***

**Soybean: Purple stain caused by *Cercospora kikuchii***

The development of seed health standards for managing purple stain of soybean, caused by *Cercospora kikuchii*, is crucial for improving seed quality and ensuring sustainable soybean production. This initiative was undertaken by multiple centres, including IARI, New Delhi;

JNKVV, Jabalpur; MPKV, Rahuri; and PJTSAU, Hyderabad, with the objective of establishing reliable detection thresholds and diagnostic protocols.

The compiled results indicated that 0.3% seed infection led to significant disease development in the subsequent season. Based on these findings across centres, the proposed seed health standard for foundation seed in soybean is 0.3% maximum infection of *C. kikuchii*. However, this threshold requires further validation by all participating centres in the coming year before final recommendation.

❖ **Experiment 6: Systematic studies for evaluation of alternative chemicals and microbial consortia for effective management of seed-borne pathogens of major crops.**

**Crop: Lentil (Collar rot)**

At JNKVV, Jabalpur, maximum mycelial growth in control was recorded for *Fusarium oxysporum* f. sp. *lentis* (84 mm) and *Sclerotium rolfsii* (90 mm). Among fungicides, 100% inhibition of *F. oxysporum* was achieved with Tebuconazole and Carboxin + Thiram at both doses, while Pyraclostrobin + Epoxyconazole (87.86%) and Propiconazole + Difenoconazole (86.93%) were also highly effective. For *S. rolfsii*, complete inhibition (100%) was observed with Azoxystrobin + Difenoconazole, Difenoconazole, Tebuconazole, Tebuconazole + Zineb, and Carbendazim + Thiram; Difenoconazole + Fluxapyroxad (86.00%) and Pyraclostrobin + Metiram (85.78%) were also effective. Overall, triazole-based fungicides and combinations were most effective, while Pyraclostrobin and Azoxystrobin alone were less effective.

At AAU, Jorhat, in single dose, Tebuconazole showed highest inhibition (86.29%), followed by Pyraclostrobin + Metiram (85.92%), both statistically at par. In double dose, Trifloxystrobin + Tebuconazole and Pyraclostrobin + Metiram recorded highest inhibition (89.62% each), followed by Propiconazole + Difenoconazole, Tebuconazole, and Azoxystrobin + Tebuconazole (89.25%), all statistically at par.

At GBPUAT, Pantnagar, Azoxystrobin + Difenoconazole, Propiconazole + Difenoconazole, Penflufen + Trifloxystrobin, Trifloxystrobin + Tebuconazole, Pyraclostrobin + Metiram, Fluxapyroxad + Pyraclostrobin, Pyraclostrobin + Epoxyconazole, and Carboxin + Thiram were highly effective against both pathogens. At IARI, New Delhi, Tebuconazole showed highest inhibition at normal dose, followed by Pyraclostrobin + Metiram. At double dose, Trifloxystrobin + Tebuconazole and Pyraclostrobin + Metiram were most effective. Cost considerations are important before final recommendations.

**Crop: Chickpea (wilt)**

At AAU, Anand, all fungicides significantly reduced mycelial growth of *F. oxysporum* f. sp. *ciceris* over control. At the recommended (X) dose (0.05%), Propiconazole + Difenoconazole, Tebuconazole 15% + Zineb 57% WDG, and Carboxin 37.5% + Thiram 37.5% DS recorded complete inhibition (0 mm colony diameter). At double (2X) dose (0.1%), cent per cent inhibition was observed with Propiconazole + Difenoconazole, Tebuconazole + Zineb, Tebuconazole, and Carboxin + Thiram. Against *S. rolfsii*, all fungicides reduced growth, with

inhibition increasing at higher concentrations. Maximum inhibition (100%) at X dose was recorded with Pyraclostrobin (0.05%). At 2X dose, complete inhibition was achieved with Pyraclostrobin (0.1%), Difenoconazole (0.2%), Trifloxystrobin + Tebuconazole (0.1%), and Pyraclostrobin + Metiram (0.2%).

At RARI, Durgapura, distinct differences were observed in fungicide performance. At X dose, complete inhibition (100%) of *F. oxysporum* f. sp. *ciceris* was recorded with Tebuconazole, Tebuconazole + Zineb, Trifloxystrobin + Tebuconazole, and Azoxystrobin + Tebuconazole. Propiconazole + Difenoconazole showed near-complete inhibition (99.63%), followed by Difenoconazole + Fluxapyroxad (98.15%) and Carboxin + Thiram (95.19%). Lower efficacy was recorded with Penflufen + Trifloxystrobin (77.78%) and Pyraclostrobin (74.44%). At 2X dose, complete inhibition was achieved by Propiconazole + Difenoconazole, Difenoconazole + Fluxapyroxad, Tebuconazole, Tebuconazole + Zineb, Trifloxystrobin + Tebuconazole, and Azoxystrobin + Tebuconazole. Azoxystrobin + Difenoconazole (99.63%) and Carboxin + Thiram (98.89%) remained highly effective, while Penflufen + Trifloxystrobin (87.41%) and Pyraclostrobin (82.59%) were least effective. Overall, triazole-based fungicides, particularly Tebuconazole alone or in combination, showed superior performance, and combination products generally outperformed single molecules due to multiple modes of action.

At PJTSAU, Hyderabad, poisoned food technique studies revealed that at X dose, Propiconazole + Difenoconazole and Tebuconazole recorded 89.89% reduction of *Fusarium*, followed by Penflufen + Trifloxystrobin (88.84%). The least reduction was observed with Azoxystrobin + Difenoconazole (65.81%). At 2X dose, all fungicides completely inhibited *Fusarium*. Against *Sclerotium*, all fungicides achieved 100% inhibition at both doses, except Pyraclostrobin, Azoxystrobin + Tebuconazole, and Pyraclostrobin + Epoxyconazole. Seed health analysis indicated association of *Alternaria* (44.44%), *Ascochyta rabiei* (22.22%), and *Curvularia*, *Fusarium*, and *Aspergillus* (11.11% each) in chickpea seed samples from Telangana.

At GBPUAT, Pantnagar, several fungicides including Azoxystrobin + Difenoconazole, Propiconazole + Difenoconazole, Penflufen + Trifloxystrobin, Trifloxystrobin + Tebuconazole, Pyraclostrobin + Metiram, Fluxapyroxad + Pyraclostrobin, Pyraclostrobin + Epoxyconazole, and Carboxin + Thiram were found highly effective against both *Fusarium* and *Sclerotium*. At JNKVV, Jabalpur, all fungicides significantly reduced growth of *F. oxysporum* (control: 90 mm). Tebuconazole and Carbendazim + Thiram recorded complete inhibition (0 mm, 100%) at both doses. Among combinations, Pyraclostrobin + Epoxyconazole (86.89% and 85.44%) and Propiconazole + Difenoconazole (85.87% and 84.56%) were highly effective, followed by Trifloxystrobin + Tebuconazole and Tebuconazole + Zineb (>82%). Pyraclostrobin alone was least effective (61.22% and 53%).

At IARI, New Delhi, complete inhibition at X dose was achieved by Trifloxystrobin + Tebuconazole, Azoxystrobin + Tebuconazole, Tebuconazole, and Tebuconazole + Zineb. However, it was emphasized that if Tebuconazole alone provides 100% inhibition, combining it with Zineb may unnecessarily increase costs. Hence, economic considerations are critical

before recommending fungicides. At MPKV, Rahuri, fungicides such as Tebuconazole and Carboxin + Thiram recorded 100% inhibition of *F. oxysporum*, followed by Pyraclostrobin + Epoxyconazole (86.62%), Propiconazole + Difenoconazole (85.50%), Tebuconazole + Zineb (83.64%), Trifloxystrobin + Tebuconazole (83.27%), Difenoconazole (82.16%), and Azoxystrobin + Tebuconazole (81.04%).

**Crop: Chickpea – Collar rot *(Sclerotium rolfsii)***

At MPKV, Rahuri, poison food technique studies showed that several newer fungicides were highly effective against *Sclerotium rolfsii*. Complete inhibition (100%) was recorded with Azoxystrobin + Difenoconazole, Difenoconazole, Tebuconazole, Tebuconazole 15% + Zineb 57% WDG, and Carboxin 37.5% + Thiram 37.5% DS. These were followed by Pyraclostrobin + Metiram (87.36%), Difenoconazole + Fluxapyroxad (86.99%), Fluxapyroxad + Pyraclostrobin (84.76%), Propiconazole + Difenoconazole (83.27%), Pyraclostrobin + Epoxyconazole (82.53%), and Azoxystrobin + Tebuconazole (81.41%).

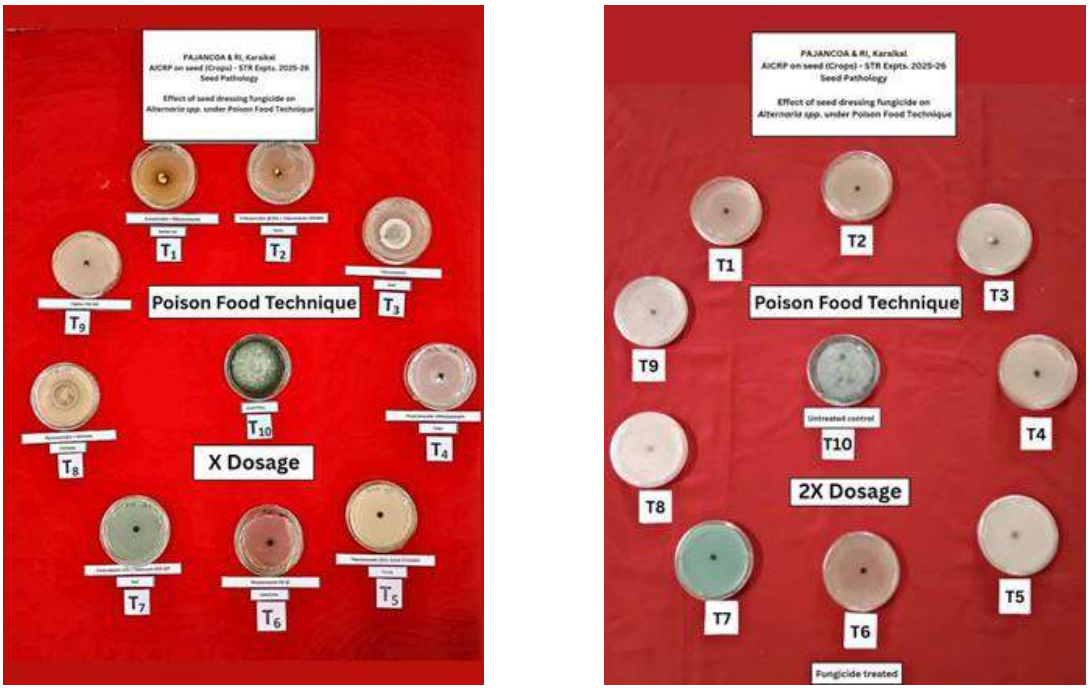
**Crop: Chilli** (***Alternaria solani***)

At ICAR NEHR, Manipur, fungicides were evaluated against *Alternaria solani* using the poison food technique. All treatments showed variable antifungal activity, with inhibition ranging from 57.41–100% at X concentration and 48.15–100% at 2X. Captan (75 EC), Tebuconazole, and Hexaconazole recorded complete inhibition (100%) of mycelial growth, indicating maximum efficacy. Tebuconazole 15% + Zineb 57% SC and Propiconazole + Difenoconazole also showed high inhibition (94.07% and 90.37%, respectively). Moderate effectiveness was observed with Trifloxystrobin 25% + Tebuconazole 50% WG (85.56%), Carbendazim + Mancozeb (75.56%), and Pyraclostrobin + Metiram (72.22%), while Azoxystrobin + Difenoconazole (57.41%) was least effective. No significant difference in inhibition was observed between X and 2X concentrations. Untreated control recorded maximum growth. X concentration was considered adequate for seed dressing.

At JNKVV, Jabalpur, maximum mycelial growth of *Alternaria alternata* (88.8–89.2 mm) was recorded in control. Complete inhibition (100%) was achieved with Tebuconazole (Raxil) and Hexaconazole at both doses. Among combinations, Propiconazole + Difenoconazole (83.96%) and Azoxystrobin + Difenoconazole (79.2%) were highly effective, followed by Pyraclostrobin + Metiram (76.5–72.13%). Carbendazim + Mancozeb (45.54–31.94%) and Captan (24.52–11.52%) were least effective. Triazole fungicides were overall most effective.

At AAU, Jorhat, Hexaconazole 5% SC showed the highest inhibition at single dose (86.62%), followed by Azoxystrobin + Difenoconazole (85.92%). At double dose, Hexaconazole achieved 100% inhibition, followed by Azoxystrobin + Difenoconazole and Tebuconazole 15% + Zineb 57% WDG (88.14% each), and Trifloxystrobin 25% + Tebuconazole 50% WG (87.03%). At TNAU, Coimbatore, against *Colletotrichum* sp., Carbendazim 12% + Mancozeb 63% WP (0.1 and 0.2%), Tebuconazole 15% + Zineb 57% WDG (0.2 and 0.4%), and Trifloxystrobin 25% + Tebuconazole 50% WG (0.05 and 0.1%) recorded 100% inhibition. Against *Alternaria* sp.,

Carbendazim + Mancozeb and Pyraclostrobin + Metiram achieved complete inhibition, followed by Propiconazole + Difenoconazole.




**Evaluation of novel fungicides against *Alternaria* spp. In chilli at PAJANCOA&RI, Karaikal**

At MPKV, Rahuri, Tebuconazole and Hexaconazole 5% SC were statistically superior, achieving 100% inhibition of *Alternaria alternata*. Other effective treatments included Propiconazole + Difenoconazole (82.71%), Azoxystrobin + Difenoconazole (78.57%), Pyraclostrobin + Metiram (73.69%), and Tebuconazole + Zineb (71.80%). At GBPUAT, Pantnagar, Trifloxystrobin 25% + Tebuconazole 50% WG and Azoxystrobin + Difenoconazole were highly effective against *Alternaria* and *Colletotrichum*. Several fungicides showed 100% inhibition at tested doses, suggesting the need to determine minimum inhibitory concentrations at lower doses.

At PAU, Ludhiana, maximum inhibition (100%) was achieved with Trifloxystrobin 25% + Tebuconazole 50% WG and Tebuconazole 5.36% FS at 0.05%. At OUAT, Bhubaneswar, Pyraclostrobin + Metiram and Tebuconazole + Zineb showed the highest inhibition of *Alternaria* sp. At PAJANCOA & RI, Karaikal, complete inhibition (100%) of *Alternaria* sp. was observed with Propiconazole + Difenoconazole, Tebuconazole + Zineb, Hexaconazole 5% SC, Carbendazim + Mancozeb, and Captan at both X and 2X doses. Tebuconazole alone showed 19.43% inhibition at X and 85.18% at 2X. Trifloxystrobin 25% + Tebuconazole 50% WG, Azoxystrobin + Difenoconazole, and Trifloxystrobin achieved 100% inhibition at 2X, with 83.48% and 80.11% inhibition at X dose, respectively.

**Crop: Tomato**

At NEHR, Manipur, fungicides were evaluated against *Alternaria solani* using the poison food technique. Considerable variation in antifungal efficacy was observed, with inhibition ranging

from 57.41–100% at X concentration and 48.15–100% at 2X. Captan (75 EC), Tebuconazole, and Hexaconazole achieved complete inhibition (100%) of mycelial growth. Tebuconazole 15% + Zineb 57% SC and Propiconazole + Difenoconazole also showed high inhibition (94.07% and 90.37%, respectively). Moderate efficacy was recorded with Trifloxystrobin 25% + Tebuconazole 50% WG (85.56%), Carbendazim + Mancozeb (75.56%), and Pyraclostrobin + Metiram (72.22%), while Azoxystrobin + Difenoconazole (57.41%) was least effective. No significant difference was observed between X and 2X doses. The untreated control recorded maximum growth, and X dose was considered adequate for seed dressing in chilli and tomato.

At RARI, Durgapura, fungicides against *Alternaria* spp. showed clear differences at X and 2X doses. At X dose, Azoxystrobin + Difenoconazole and Trifloxystrobin + Tebuconazole achieved 100% inhibition. Tebuconazole (99.26%), Carbendazim + Mancozeb (98.89%), Propiconazole + Difenoconazole and Hexaconazole (98.52% each), and Tebuconazole + Zineb (96.30%) was also highly effective. Captan was least effective (81.11%). At 2X dose, most fungicides showed complete inhibition (100%), including Azoxystrobin + Difenoconazole, Trifloxystrobin + Tebuconazole, Tebuconazole, Propiconazole + Difenoconazole, Tebuconazole + Zineb, and Hexaconazole, while Carbendazim + Mancozeb recorded 99.63%. Captan remained least effective (85.56%). Overall, triazole fungicides and combinations showed superior efficacy.

At PAJANCOA & RI, Karaikal, Propiconazole + Difenoconazole, Tebuconazole + Zineb, Hexaconazole 5% SC, Carbendazim + Mancozeb, and Captan achieved 100% inhibition at both X and 2X doses. Trifloxystrobin 25% + Tebuconazole 50% WG, Azoxystrobin + Difenoconazole, and Trifloxystrobin recorded 100% inhibition at 2X, with 84.27% and 81.46% inhibition at X dose. Tebuconazole alone was least effective at X (20.67%) but improved at 2X (85.18%). At JNKVV, Jabalpur, control recorded maximum growth of *Alternaria alternata* (88.5–88.8 mm). Tebuconazole showed complete inhibition (100%) at both doses. Hexaconazole (85.2%) and Propiconazole + Difenoconazole (84.85%) were also effective, followed by Azoxystrobin + Difenoconazole (82.82%) and Pyraclostrobin + Metiram (78.64%). Carbendazim + Mancozeb (51.64–36.56%) and Captan (19.1–9.36%) were least effective. Triazoles were most effective overall.

At GBPUAT, Pantnagar, Trifloxystrobin 25% + Tebuconazole 50% WG and Azoxystrobin + Difenoconazole were highly effective against *Alternaria* and *Colletotrichum*. Many fungicides showed 100% inhibition at tested doses, indicating the need to determine minimum inhibitory concentrations at lower doses. At AAU, Anand, all fungicides significantly reduced *Alternaria* growth compared to control. Maximum inhibition (100%) was recorded with Propiconazole + Difenoconazole, Tebuconazole + Zineb, Captan 75% WP (0.25%), and Hexaconazole (0.1%) at both 0.05% and 0.1% concentrations. At PJTSAU, Hyderabad, Picoxystrobin 7.05% + Propiconazole 11.71% SC and Hexaconazole 5% SC showed highest inhibition (92.71% reduction over control), followed by Propiconazole + Difenoconazole (88.97%). Captan 75% WP was least effective at X dose (26.50%). At 2X dose, all fungicides showed 100% inhibition except Azoxystrobin + Difenoconazole and Captan.

At AAU, Jorhat, Hexaconazole 5% SC recorded the highest mycelial inhibition at single dose (89.62%), followed by Azoxystrobin + Difenoconazole (87.03%). At double dose, Hexaconazole achieved complete inhibition (100%), while Azoxystrobin + Difenoconazole and Tebuconazole 15% + Zineb 57% WDG showed 88.14% inhibition each, followed by Trifloxystrobin 25% + Tebuconazole 50% WG (87.03%). At TNAU, Coimbatore, Carbendazim 12% + Mancozeb 63% WP (0.1 and 0.2%) and Pyraclostrobin 5% + Metiram 55% WG (0.2%) recorded 100% inhibition of *Alternaria* sp., followed by Tebuconazole 15% + Zineb 57% WDG (0.2 and 0.4%).

At MPKV, Rahuri, Tebuconazole showed complete inhibition (100%) of *Alternaria alternata* in tomato. Other effective fungicides included Hexaconazole 5% SC (85.17%), Propiconazole + Difenoconazole (83.28%), Azoxystrobin + Difenoconazole (81.75%), and Pyraclostrobin + Metiram (77.18%). At PAU, Ludhiana, maximum inhibition was observed with Trifloxystrobin 25% + Tebuconazole 50% WG and Tebuconazole 5.36% FS at 0.1% concentration. At OUAT, Bhubaneswar, Propiconazole + Difenoconazole and Pyraclostrobin + Metiram showed superior control of *Alternaria* sp. with maximum growth inhibition. At PAJANCOA & RI, Karaikal, Propiconazole + Difenoconazole, Tebuconazole 15% + Zineb 57% WDG, Hexaconazole 5% SC, Carbendazim + Mancozeb, and Captan achieved complete inhibition (100%) at both X and 2X doses. Trifloxystrobin 25% + Tebuconazole 50% WG and Azoxystrobin + Difenoconazole showed 100% inhibition at 2X, with 84.27% and 81.46% inhibition at X dose, respectively. Tebuconazole alone was least effective at X (20.67%) but improved at 2X (85.18%).

**Crop: Sunflower**

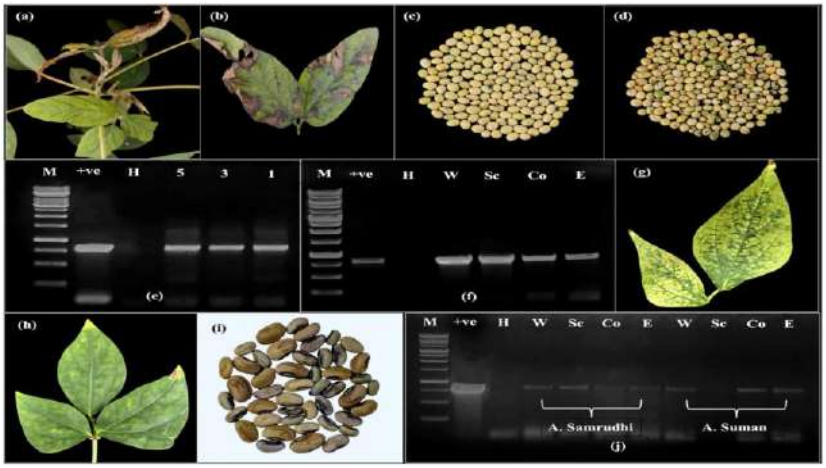
At PAJANCOA & RI, Karaikal, Propiconazole + Difenoconazole, Tebuconazole 15% + Zineb 57% WDG, Hexaconazole 5% SC, Carbendazim 12% + Mancozeb 63% WP, and Captan achieved complete inhibition (100%) of *Alternaria* sp. at both X and 2X doses under in vitro conditions. In contrast, Azoxystrobin + Difenoconazole and Trifloxystrobin, as well as Trifloxystrobin 25% + Tebuconazole 50% WG, showed lower efficacy at X dose, recording 83.93% and 82.02% inhibition, respectively, but achieved 100% inhibition at 2X. Tebuconazole alone was least effective at X (19.10%) but improved at 2X (81.85%). At MPKV, Rahuri, Tebuconazole recorded complete inhibition (100%) of *Alternaria alternata* in sunflower. Other effective fungicides included Azoxystrobin + Difenoconazole (82.15%), Propiconazole + Difenoconazole (81.04%), Hexaconazole 5% SC (78.81%), Pyraclostrobin + Metiram (75.46%), and Tebuconazole 15% + Zineb 57% WDG (70.63%). At PJTSAU, Hyderabad, at 1X dose, Tebuconazole 15% + Zineb 57% WDG showed the highest reduction over control (93.30%), followed by Propiconazole + Difenoconazole (91.13%) and Hexaconazole 5% SC (90.54%). Captan 75% WP was least effective. At 2X dose, all fungicides achieved 100% inhibition except Captan (43.89%). At TNAU, Coimbatore, Carbendazim 12% + Mancozeb 63% WP (0.2%) and Pyraclostrobin 5% + Metiram 55% WG (0.2%) recorded complete inhibition (100%) of *Alternaria* sp. in sunflower.

**Crop: Cumin**

At AAU, Anand, all fungicides significantly reduced the growth of *Alternaria* spp. causing cumin blight compared to control. Complete inhibition (100%) was recorded with Propiconazole + Difenoconazole, Tebuconazole 15% + Zineb 57% WDG, Captan 75% WP (0.25%), and Hexaconazole (0.1%) at both 0.05% and 0.1% concentrations. At RARI, Durgapura, similar results were observed. However, further multi-location evaluation is needed, and trials should be continued at additional centres to enable firm recommendations by 2027–28.

❖ **Experiment 7: Multi-location assessment of seed-borne viral pathogens in major pulse/soybean crops and development of integrated seed health management strategies**

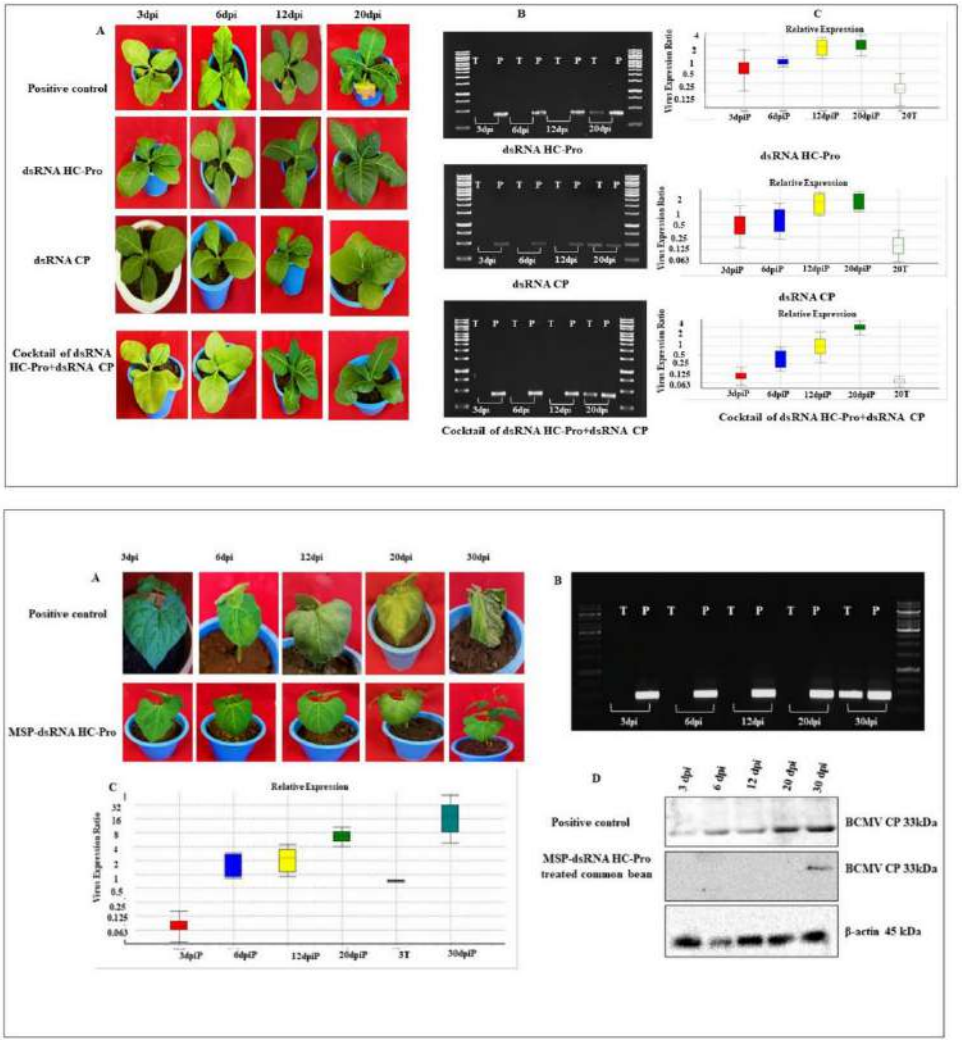
At IARI, New Delhi, a study was conducted during 2025 to assess seed transmission of cowpea mild mottle virus (CPMMV), causing veinal necrosis and bud blight (VNB) in soybean (Glycine max), under Indian agroecological conditions. Seeds were collected from CPMMV-infected soybean genotypes and from mechanically sap-inoculated cowpea genotypes, Arka Samrudhi and Arka Suman. DAC-ELISA failed to detect the virus in soybean and cowpea seeds, as indicated by low absorbance values. However, RT-PCR using coat protein (CP)-specific primers confirmed CPMMV presence in whole seed, seed coat, cotyledons, and embryo through amplification of an 867 bp fragment. Grow-out assays showed vertical transmission to $F_1$ (75%) and $F_2$ (100%) progenies, which expressed necrotic spot symptoms; infection was validated by RT-PCR and RT-qPCR.




**ICAR-IARI, New Confirmation of seed transmissibility in soybean and cowpea. (a) Symptomatic soybean plant showing necrosis and bud blight. (b) Necrotic symptoms on the leaf. (c) Healthy seed harvested from non-symptomatic plant. (d) Diseased seed harvested from necrotic CPMMV infected plant showing crinkling and discolouration. (e) Detection of CPMMV through RT-PCR with CP specific primers in group of five, three and single seed (H-RT-PCR from healthy whole seed; +ve-Leaf tissue infected with CPMMV; M-Generuler 1 kb DNA ladder) (f) PCR amplicons (867 bp) obtained with CP specific primers NS77F and NS77R in different seed parts (W-Whole seed; Sc-Seed coat; Co-Cotyledons; E-Embryo). (g) Symptoms of chlorotic and necrotic spots sap inoculated Arka Suman. (h) Chlorotic spots and blotches Arka Samrudhi. (i) Discolored and low weight seeds obtained from mechanically sap inoculated cowpea plants. (j) RT-PCR confirmation of CPMMV in whole seed and seed parts of mechanically sap inoculated cowpea cvs A. Samrudhi and A. Suman. (Dhruva *et al*., 2025).**

At JNKVV, Jabalpur, under multi-location assessment, virus-infected soybean leaf samples were collected and sent to IARI, New Delhi for molecular analysis. Infected plants were tagged, and corresponding seed samples were collected and forwarded for detection and characterization of seed-borne viral pathogens. These samples will support advanced molecular diagnostics for identification and quantification of viral load and diversity, aiding development of diagnostic tools and integrated seed health management strategies in soybean. At AAU, Anand, RT-PCR using ULCV-specific coat protein primers amplified ~1000 bp fragments in all symptomatic leaf samples. BLASTn sequence analysis showed no high-confidence matches under default parameters, indicating possible sequence divergence, low database representation, or potential novelty of the isolate.

At SKUAST-Srinagar, RT-PCR using coat protein-specific primers amplified ~442 bp, ~800 bp, ~1443 bp, and ~450 bp fragments corresponding to BCMV, BCMNV, CYVV, and CMV, respectively, in symptomatic bean, moong bean, and soybean samples. BLASTn analysis confirmed virus presence. dsRNA-induced RNA interference (RNAi) was used to induce resistance against Bean Common Mosaic Virus (BCMV), where single and multiple dsRNA sprays induced resistance from 12–50 DPI (Wani et al., 2025; Iralu et al., 2026).




**Molecular detection of BCMV, BCMNV, CYVV and CMV viruses in beans at SKUAST, Srinagar**

## D. Seed Entomology

Under seed entomology, five experiments *viz.* Survey and evaluation of seed health status of farmers' saved seed with respect to insect infestation; evaluation of efficacy of commercial formulation of entomopathogens and inert dust on storage insect pests and seed quality during storage under ambient condition; evaluation of plant based neutral silica on storage insects and seed quality during storage under ambient condition; studies on the effect of insecticidal seed treatment on seed viability during storage under ambient condition and evaluation of newer insecticides as alternative of deltamethrin for seed storage godown disinfection were taken up during 2025-26. Except survey on seed health status of farmers' saved seed, other experiments deal with various methods of controlling storage insects including physical, biological, and chemical methods.

❖ **Survey and evaluation of seed health status of farmers' saved seed**

The survey was conducted in nine states and one union territory across the country and about 2695 farmers' saved seed samples have been collected and analysed for seed quality. The survey revealed that 50% seed samples were infested with various storage pests and 38.8% samples had insect damage beyond permissible limit. However, 69.7% seed samples had germination above IMSCS.

- Out of 506 (18.8% of total samples collected) of samples collected from Karnataka and Puducherry about 94.3% samples were infested and 93.9% samples had insect damage above IMSCS whereas only 21.3 % samples had seed germination above IMSCS.
- Out of 980 samples (36.4% samples of total collected samples) collected from Gujrat, Maharashtra, and UP, only 11.1% were infested with storage insects. Only 3.1 % samples collected from these areas failed meet the standard of insect damage and 87.9% of these samples maintained the standard of seed germination as per IMSCS.
- Out of 1209 seed samples (44.9% of total collected samples) collected from Tamil Nadu, Telangana, Rajasthan, Odisha and Assam 63% samples had insect infestation and 44.7% samples had insect damage beyond permissible limit. However, 75.3% samples had seed germination above IMSCS.

Therefore, state specific advisories to respective State Dept. of Agriculture is required for improvement of seed health status of farmers' saved seed.

**Table 4.1: Seed health status of farmer's saved seed with respect to storage insects**

| Name of centre | No. of sample | Crops | Storage period (months) | Per cent infested sample | Insect recorded | Intensity of insect damage (%) | Samples with insect damage beyond permissible limit (%) | Seed germination (%) range | Samples having Germination above IMSCS (%) |
|---|---|---|---|---|---|---|---|---|---|
| UAS, Bangalore | 212 | Chickpea, cowpea, horse gram, fieldbean | 2-12 | 100 | Cc | 1.0-28.5 | 99.5 | 34-87 | 18.9 |
| PAJANCOA, Karaikal | 153 | Paddy | 2-22 | 100 | Rd, Sc, Sg | 1.0-60 | 100 | 0-93 | 20.3 |
| UAS, Dharwad | 141 | Chickpea, sorghum, wheat | 2-9 | 79.4 | Cc, So | 0.0-13.04 | 78.7 | 55-87 | 26.2 |
| TNAU, Tamil Nadu | 100 | Paddy, groundnut, Ragi | 4-6 | 80.0 | Rd, Sc, Cs | 0.00-20.0 | 79.0 | 50-96 | 85.0 |
| OUAT, Bhubaneswar | 395 | Paddy, green gram, black gram | 4-6 | 59.7 | Rd, Sc, Cc | 0.0-28 | 56.7 | 0-97 | 45.3 |
| AAU, Jorhat | 310 | Paddy, black gram, toria | 5-7 | 57.4 | Rd, Sc, So, Tc, Cc | 0.0-2.5 | 7.1 | 71-100 | 93.5 |
| PJTSAU, Telangana | 302 | Paddy, black gram, green gram, red gram | 6 | 75.2 | Sc, Cc | 0.0-11.5 | 57.9 | 62-100 | 98.0 |
| SKNAU, Jobner | 102 | Wheat, pearl millet | 1-7 | 40.2 | Rd, So, Tc, Tg | 0.0-25.5 | 40.2 | 64-89 | 58.8 |
| CSUAT, Kanpur | 60 | Wheat, field pea | 5-12 | 0.0 | Rd, Tc, Sc | 0.0 | 0.0 | 66-93 | 58.3 |
| PDKV, Akola | 176 | Chickpea, soybean | 6-7 | 31.8 | Cc, Rd | 0.20-1.50 | 1.7 | 49-89 | 88.6 |
| MPKV, Rahuri | 398 | Pigeon pea, wheat, chickpea, soybean | 6-8 | 6.8 | Cm, So, Rd | 0.0-7.0 | 5.0 | 60-98 | 88.7 |
| NISST, Mau | 228 | Wheat | 6 | 1.8 | Rd, So, Tc | 0.0-0.75 | 0.44 | 33-100 | 87.3 |
| JAU, Junagadh | 118 | Groundnut | 7-8 | 18.64 | *Cs, Tc* | 0.0-6.0 | 5.08 | 72-100 | 100 |
| **Total** | 2695 | - | - | 50.0 | - | - | 38.8 | - | 69.7 |

Rd – *Rhyzopertha dominica* (Lesser grain borer); So – *Sitophilus oryzae* (Rice weevil); Cc – *C. chinensis* (Pulse beetle); Sc – *Sitotroga cerealella* (Angoumois grain moth); Tc - *Tribolium castaneum* (Red flour beetle); *Cs-Corcyra cephalonica* (Rice moth); *Cm-C. maculatus, Os-Oryzaephilus surinamensis*

❖ **Studies on the effect of Entomopathogens and inert dust on storage insect pests and seed viability during storage under ambient condition.**

Two commercial formulations (1.2X10$^8$ CFU) of *Beauveria bassiana* and *Metarhizium anisopliae* were tried for management of storage insects of cereals and pulses. Although there were some variations in storability of different crops primarily due to agro-climatic conditions, combinations of both the entomopathogens with diatomaceous earth (T5, T6, T7 & T8) restricted insect damage within permissible limit and maintained seed germination above IMSCS up to 6-9 months of storage in most of the crops. However, T6 (*Beauveria bassiana* (CFU: 1.0 X10$^8$) @ 20g /kg seed +Diatomaceous earth @ 5g /kg seed) & T8 (*Metarhizium anisopliae* (CFU: 1.0 X10$^8$) @20g /kg seed+ Diatomaceous earth @ 5g /kg seed) excelled over other treatments for longer duration of storage (>6months). Thus, it can be concluded that combinations of both the entomopathogens @ 20g /kg seed with diatomaceous earth@ 5g /kg seed can provide effective management of storage insects in paddy, wheat, maize, sorghum, pearl millet, green gram, black gram, cowpea, pigeon pea, chickpea and field pea without affecting seed germination up to 6-9 months.

**Table 4.2: Effective seed treatments and storage periods for different crops and at various centres**

| Crop | Centre | Safe period of storage (months) | Effective treatments |
|---|---|---|---|
| Maize | TNAU, Coimbatore | 6 | T5 (*B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed) (ID-nil),<br>T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-nil),<br>T7 (*M. anisopliae* @ 10g /kg seed +DE @ 5g /kg seed) (ID-nil),<br>T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-nil) |
| Paddy | AAU, Jorhat | 6 | T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.42%),<br>T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.25%). |
| | PAJANCOA&RI, Karaikal | 6 | T5 (*B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed) (ID-0.31%),<br>T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.14%),<br>T7 (*M. anisopliae* @ 10g /kg seed +DE @ 5g /kg seed) (ID-0.18%),<br>T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.10%) |
| | OUAT, Bhubaneswar | 6 | T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.67%),<br>T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.33%) |
| Wheat | CSAUAT, Kanpur | 9 | All seed treatments (ID-nil) |
| Sorghum | MPKV, Rahuri | 6 | T2 (*B. bassiana* @ 20g /kg seed) (ID-0.33%),<br>T5 (*B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed), (ID-0.33%),<br>T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-nil),<br>T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.33%). |
| Pearl millet | SKNAU, Jobner | 6 | T5 (*B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed), (ID-nil),<br>T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-nil),<br>T7(*M. anisopliae* @ 10g /kg seed +DE @ 5g /kg seed) (ID-nil),<br>T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-nil) |
| | JAU, Junagadh | - | T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-1.33%),<br>T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-1.00%) |

| | | | |
|---|---|---|---|
| Green gram | TNAU, Coimbatore | 9 | T5 (*B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed), (ID-0.67%), T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.50%), T7 (*M. anisopliae* @ 10g /kg seed +DE @ 5g /kg seed) (ID-0.67%), T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.50%) |
| | OUAT, Bhubaneswar | 9 | T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.67%) |
| | SKNAU, Jobner | 9 | T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-1.00%), T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.67%) |
| Cowpea | UAS, Dharwad | 6 | All seed treatments |
| Pigeon pea | PDKV, Akola | 12 | T5 (*B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed), (ID-0.94%), T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.32%), T7 (*M. anisopliae* @ 10g /kg seed +DE @ 5g /kg seed) (ID-0.23%), T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.22%) |
| | UAS, Dharwad | 6 | All seed treatments |
| Black gram | PAJANCOA, Karaikal | 9 | T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.98%), T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.84%) |
| | AAU, Jorhat | 6 | T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.83%), T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.75%) |
| Chickpea | PDKV, Akola | 12 | T5 (*B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed), (ID-0.84%), T6 (*B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.36%), T7 (*M. anisopliae* @ 10g /kg seed +DE @ 5g /kg seed) (ID-0.69%), T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-0.32%) |
| | MPKV, Rahuri | 6 | All seed treatments (ID-0.0-1.00%) |
| | JAU, Junagadh | 6 | T8 (*M. anisopliae* @ 20g /kg seed +DE @ 5g /kg seed) (ID-nil) |
| Field pea | CSAUAT, Kanpur | 9 | All seed treatments |

**Table 4.3: Effect of seed treatments involving entomopathogen and inert dust on per cent seed germination and per cent insect damage in wheat and paddy seeds**

| Symbol | Treatments | Wheat | | | | Paddy | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CSAUAT, Kanpur | | | | AAU, Jorhat | | | | OUAT, Bhubaneswar | | | | PAJANCOA&RI, Karaikal | | | |
| | | 6 months | | 9 months | | 6 months | | 9 months | | 3 months | | 6 months | | 3 months | | 6 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | *B. bassiana* @ 10g /kg seed | 91.0 (72.53) | 0.00 | 86.7 (68.56) | 0.00 (0.71) | 76.7 (61.10) | 2.67 (1.77) | 68.7 (55.94) | 2.83 (1.82) | 88.0 (69.71) | 0.33 (0.88) | 84.3 (66.66) | 2.67 (1.76) | 92 (73.60) | 0.36 (0.93) | 86 (68.03) | 1.11 (1.27) |
| $T_2$ | *B. bassiana* @ 20g /kg seed | 91.7 (73.28) | 0.00 | 87.0 (68.85) | 0.00 (0.71) | 73.3 (58.89) | 3.17 (1.91) | 70.7 (57.19) | 3.33 (1.96) | 87.7 (69.43) | 0.33 (0.88) | 85.3 (67.47) | 2.33 (1.68) | 94.5 (75.33) | 0.18 (0.82) | 89.0 (70.19) | 0.89 (1.18) |
| $T_3$ | *M. anisopliae* @10g /kg seed | 90.0 (71.58) | 0.00 | 88.0 (69.71) | 0.00 (0.71) | 78.7 (62.47) | 2.83 (1.82) | 74.7 (59.76) | 2.83 (1.82) | 88.7 (70.31) | 0.67 (1.05) | 84.7 (66.93) | 2.33 (1.68) | 94.5 (76.55) | 0.37 (0.93) | 85.0 (68.07) | 0.75 (1.12) |
| $T_4$ | *M. anisopliae* @20g /kg seed | 91.7 (73.20) | 0.00 | 90.0 (71.55) | 0.00 (0.71) | 72.0 (58.03) | 2.17 (1.63) | 67.3 (55.12) | 3.33 (1.96) | 87.0 (68.85) | 0.00 (0.71) | 85.0 (67.22) | 1.67 (1.46) | 95.5 (77.96) | 0.13 (0.80) | 88.0 (69.33) | 0.53 (1.02) |
| $T_5$ | *B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed | 89.7 (71.22) | 0.00 | 88.0 (69.71) | 0.00 (0.71) | 80.3 (63.65) | 1.67 (1.47) | 74.7 (59.76) | 2.67 (1.78) | 87.0 (68.85) | 0.33 (0.88) | 84.3 (66.67) | 1.67 (1.46) | 92.0 (74.82) | 0.22 (0.85) | 89.0 (69.31) | 0.31 (0.90) |
| $T_6$ | *B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed | 92.0 (73.56) | 0.00 | 90.0 (71.55) | 0.00 (0.71) | 84.7 (66.93) | 0.42 (0.96) | 81.3 (64.38) | 1.17 (1.29) | 88.0 (69.71) | 0.00 (0.71) | 85.7 (67.74) | 0.67 (1.05) | 95.5 (76.84) | 0.09 (0.77) | 90.0 (72.08) | 0.14 (0.80) |
| $T_7$ | *M. anisopliae* @10g /kg seed+ DE @ 5g /kg seed | 92.3 (73.92) | 0.00 | 89.0 (70.61) | 0.00 (0.71) | 81.3 (64.38) | 2.33 (1.68) | 77.3 (61.55) | 3.17 (1.91) | 87.0 (68.85) | 0.00 (0.71) | 85.7 (67.73) | 1.00 (1.17) | 92.0 (74.26) | 0.26 (0.87) | 87.5 (69.31) | 0.18 (0.83) |
| $T_8$ | *M. anisopliae* @20g /kg seed+ DE @ 5g /kg seed | 93.3 (75.02) | 0.00 | 91.0 (72.53) | 0.00 (0.71) | 84.0 (66.40) | 0.25 (0.87) | 80.0 (63.43) | 1.33 (1.35) | 89.0 (70.61) | 0.00 (0.71) | 86.0 (68.01) | 0.33 (0.88) | 96.0 (78.62) | 0.13 (0.80) | 89.0 (70.70) | 0.10 (0.77) |
| $T_9$ | Deltamethrin@1ppm | 91.3 (72.89) | 0.00 | 86.3 (68.31) | 0.00 (0.71) | 85.3 (67.46) | 0.00 (0.71) | 82.7 (65.38) | 0.17 (0.81) | 86.7 (68.57) | 0.00 (0.71) | 84.7 (66.93) | 0.67 (1.05) | 94.5 (76.55) | 0.09 (0.77) | 88.0 (70.19) | 0.64 (1.07) |
| $T_{10}$ | Untreated control | 89.0 (70.6) | 0.00 | 73.00 (58.7) | 9.67 (3.17) | 65.3 (53.9) | 11.00 (3.39) | 57.33 (49.2) | 13.33 (3.72) | 85.3 (67.5) | 6.33 (2.60) | 82.00 (64.9) | 6.00 (2.53) | 91 (72.08) | 0.89 (1.18) | 82 (64.52) | 1.91 (1.55) |
| | $CD_{0.05}$ | 2.13 | - | 1.87 | 0.22 | 1.36 | 0.17 | 1.46 | 0.14 | 1.64 | 0.36 | 1.69 | 0.49 | 3.39 | 0.017 | 2.51 | 0.02 |

**G- Per cent seed germination, ID- per cent insect damage* *N.B. figures in parentheses are transformed values*

**Table 4.4: Effect of seed treatments involving entomopathogen and inert dust on per cent seed germination and per cent insect damage in maize, pearl millet and sorghum seeds**

| Symbol | Treatments | Maize | | | | Pearl millet | | | | | | | | Sorghum | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TNAU, Coimbatore | | | | SKNAU, Jobner | | | | JAU, Junagadh | | | | MPKV, Rahuri | | | |
| | | 6 months | | 9 months | | 3 months | | 6 months | | 3 months | | 6 months | | 6 months | | 9 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | *B. bassiana* @ 10g /kg seed | 88.0 | 1.50 (1.41) | 84.0 (66.42) | 2.33 (1.68) | 90.3 (72.06) | 0.00 (0.71) | 88.0 (69.75) | 0.67 (1.05) | 74.0 (59.34) | 5.00 (2.35) | 70.7 (57.19) | 8.00 (2.92) | 90.7 (72.19) | 0.67 (1.00) | 87.0 (68.85) | 3.67 (2.00) |
| $T_2$ | *B. bassiana* @ 20g /kg seed | 88.7 | 0.67 (1.07) | 84.7 (66.93) | 1.17 (1.29) | 93.0 (74.65) | 0.00 (0.71) | 89.3 (70.94) | 0.67 (1.05) | 78.0 (62.03) | 4.67 (2.27) | 73.0 (58.69) | 5.33 (2.41) | 91.7 (73.24) | 0.33 (0.88) | 89.0 (70.65) | 3.00 (1.86) |
| $T_3$ | *M. anisopliae* @10g /kg seed | 88.0 | 1.17 (1.29) | 83.3 (65.89) | 2.67 (1.77) | 92.0 (73.61) | 0.00 (0.71) | 88.3 (70.03) | 0.33 (0.88) | 75.3 (60.26) | 5.00 (2.35) | 71.7 (58.04) | 6.67 (2.68) | 91.3 (72.89) | 1.67 (1.46) | 89.0 (70.61) | 5.33 (2.40) |
| $T_4$ | *M. anisopliae* @20g /kg seed | 88.7 | 0.50 (0.98) | 84.7 (66.93) | 1.33 (1.35) | 93.0 (74.65) | 0.00 (0.71) | 89.7 (71.24) | 0.00 (0.71) | 80.0 (63.52) | 4.00 (2.12) | 73.0 (58.69) | 5.33 (2.41) | 93.3 (75.07) | 0.67 (1.00) | 91.0 (72.57) | 4.00 (2.11) |
| $T_5$ | *B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed | 87.3 | 0.00 (0.71) | 86.0 (68.03) | 0.67 (1.07) | 90.7 (72.34) | 0.00 (0.71) | 89.0 (70.61) | 0.00 (0.71) | 82.0 (64.89) | 2.33 (1.68) | 75.7 (60.42) | 3.67 (2.04) | 92.7 (74.27) | 0.33 (0.88) | 90.7 (72.19) | 2.33 (1.68) |
| $T_6$ | *B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed | 88.0 | 0.00 (0.71) | 86.7 (68.57) | 0.50 (0.98) | 93.7 (75.58) | 0.00 (0.71) | 93.3 (75.04) | 0.00 (0.71) | 82.3 (65.30) | 1.33 (1.34) | 77.0 (61.33) | 1.33 (1.34) | 93.7 (75.40) | 0.00 (0.71) | 91.0 (72.53) | 0.67 (1.05) |
| $T_7$ | *M. anisopliae* @10g /kg seed+ DE @ 5g /kg seed | 88.7 | 0.00 (0.71) | 85.3 (67.46) | 1.00 (1.21) | 89.0 (70.71) | 0.00 (0.71) | 90.3 (71.92) | 0.00 (0.71) | 80.3 (63.65) | 3.00 (1.87) | 73.3 (58.90) | 4.33 (2.20) | 91.7 (73.28) | 0.67 (1.05) | 90.0 (71.58) | 2.67 (1.77) |
| $T_8$ | *M. anisopliae* @20g /kg seed+ DE @ 5g /kg seed | 88.0 | 0.00 (0.71) | 86.0 (68.00) | 0.83 (1.15) | 94.7 (76.63) | 0.00 (0.71) | 94.3 (76.28) | 0.00 (0.71) | 85.7 (67.86) | 1.00 (1.22) | 78.3 (62.24) | 1.67 (1.46) | 92.7 (74.27) | 0.33 (0.88) | 90.3 (71.87) | 3.00 (1.86) |
| $T_9$ | Deltamethrin@1ppm | 88.0 | 1.83 (1.53) | 84.7 (66.93) | 2.83 (1.82) | 89.0 (70.68) | 0.00 (0.71) | 88.3 (70.03) | 0.00 (0.71) | 87.7 (69.57) | 0.00 (0.71) | 80.0 (63.43) | 1.00 (1.22) | 94.3 (76.3) | 0.00 (0.71) | 91.7 (73.2) | 0.00 (0.71) |
| $T_{10}$ | Untreated control | 83.3 | 7.83 (2.89) | 79.33 (62.9) | 13.50 (3.74) | 88.0 (69.7) | 0.33 (0.88) | 81.67 (64.6) | 6.33 (2.60) | 73.0 (58.7) | 8.00 (2.92) | 66.67 (54.8) | 10.67 (3.34) | 88.0 (69.71) | 6.67 (2.67) | 85.00 (67.20) | 16.00 (4.06) |
| | $CD_{0.05}$ | NS | 0.21 | 1.79 | 0.25 | 3.90 | 0.11 | 1.11 | 0.40 | 4.63 | 0.16 | 4.42 | 0.22 | 2.36 | 0.54 | 2.20 | 0.45 |

**G- Per cent seed germination, ID- per cent insect damage* *N.B. figures in parentheses are transformed values*

**Table 4.5: Effect of seed treatments involving entomopathogen and inert dust on per cent seed germination and per cent insect damage in pigeon pea and green gram seeds**

| Symbol | Treatments | Pigeon pea | | | | | | | | Green gram | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PDKV, Akola | | | | UAS, Dharwad | | | | OUAT, Bhubaneswar | | | | SKNAU, Jobner | | | | TNAU, Coimbatore | | | |
| | | 9 months | | 12 months | | 6 months | | 9 months | | 6 months | | 9 months | | 6 months | | 9 months | | 9 months | | 12 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | *B. bassiana* @ 10g /kg seed | 85.3 (67.46) | 1.41 (1.38) | 80.0 (63.41) | 2.07 (1.60) | 88.7 | 0.00 (0.71) | 86.3 (68.23) | 10.48 (3.29) | 90.3 (71.89) | 1.67 (1.46) | 81.7 (64.62) | 7.33 (2.79) | 79.3 (62.94) | 2.00 (1.56) | 74.7 (59.76) | 3.00 (1.86) | 88.0 (69.75) | 2.33 (1.68) | 84.7 (66.93) | 6.00 (2.55) |
| $T_2$ | *B. bassiana* @ 20g /kg seed | 85.3 (67.46) | 1.03 (1.24) | 80.3 (63.65) | 1.56 (1.43) | 88.7 | 0.00 (0.71) | 83.8 (66.25) | 6.51 (2.65) | 90.0 (71.55) | 1.33 (1.34) | 80.3 (63.68) | 4.33 (2.20) | 80.7 (63.90) | 1.67 (1.46) | 73.7 (59.11) | 2.33 (1.68) | 88.7 (70.31) | 2.17 (1.63) | 84.7 (66.93) | 5.83 (2.52) |
| $T_3$ | *M. anisopliae* @10g /kg seed | 84.7 (66.92) | 1.38 (1.37) | 80.7 (63.89) | 2.12 (1.62) | 89.0 | 0.00 (0.71) | 83.5 (66.02) | 7.61 (2.84) | 90.7 (72.20) | 1.33 (1.27) | 79.3 (62.94) | 3.67 (2.02) | 79.7 (63.19) | 1.33 (1.34) | 75.0 (59.98) | 2.33 (1.66) | 87.3 (69.14) | 2.50 (1.73) | 84.0 (66.40) | 5.83 (2.52) |
| $T_4$ | *M. anisopliae* @20g /kg seed | 85.0 (67.19) | 1.04 (1.24) | 80.7 (63.89) | 1.56 (1.43) | 89.0 | 0.00 (0.71) | 84.7 (67.00) | 6.07 (2.56) | 91.7 (73.22) | 1.00 (1.17) | 79.7 (63.18) | 4.33 (2.16) | 81.0 (64.14) | 1.00 (1.22) | 76.0 (60.65) | 1.67 (1.46) | 88.0 (69.70) | 2.17 (1.63) | 85.3 (67.46) | 5.67 (2.48) |
| $T_5$ | *B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed | 87.0 (68.84) | 0.42 (0.96) | 81.7 (64.62) | 0.94 (1.20) | 88.0 | 0.00 (0.71) | 84.1 (66.49) | 8.90 (3.05) | 90.3 (71.86) | 1.33 (1.29) | 80.7 (63.91) | 3.00 (1.86) | 80.7 (63.89) | 1.00 (1.17) | 76.7 (61.10) | 1.67 (1.44) | 88.7 (70.31) | 0.67 (1.07) | 84.7 (66.93) | 2.17 (1.63) |
| $T_6$ | *B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed | 86.7 (68.56) | 0.21 (0.84) | 81.7 (64.62) | 0.32 (0.90) | 90.0 | 0.00 (0.71) | 82.0 (64.85) | 2.56 (1.72) | 90.0 (71.55) | 0.67 (1.05) | 82.0 (64.87) | 1.67 (1.46) | 84.3 (66.67) | 0.67 (1.05) | 80.0 (63.41) | 1.00 (1.22) | 90.0 (71.59) | 0.50 (1.00) | 86.7 (68.57) | 1.83 (1.53) |
| $T_7$ | *M. anisopliae* @10g /kg seed+ DE @ 5g /kg seed | 86.7 (68.56) | 0.15 (0.81) | 82.0 (64.88) | 0.23 (0.85) | 88.7 | 0.00 (0.71) | 82.3 (65.08) | 4.52 (2.13) | 91.0 (72.53) | 0.67 (1.05) | 81.0 (64.14) | 2.67 (1.77) | 81.7 (64.62) | 1.00 (1.17) | 78.3 (62.24) | 1.33 (1.27) | 88.7 (70.31) | 0.67 (1.07) | 85.3 (67.46) | 2.17 (1.63) |
| $T_8$ | *M. anisopliae* @20g /kg seed+ DE @ 5g /kg seed | 86.3 (68.28) | 0.06 (0.75) | 82.3 (65.12) | 0.22 (0.85) | 89.0 | 0.00 (0.71) | 82.9 (65.56) | 2.84 (1.79) | 91.3 (72.89) | 0.00 (0.71) | 81.7 (64.63) | 0.67 (1.00) | 83.7 (66.16) | 0.33 (0.88) | 81.7 (64.63) | 0.67 (1.05) | 89.3 (70.98) | 0.50 (1.00) | 85.3 (67.46) | 1.83 (1.53) |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_9$ | Deltamethrin @ 1ppm | 85.7 (67.73) | 0.06 (0.75) | 81.7 (64.62) | 0.26 (0.87) | 87.7 | 0.00 (0.71) | 82.3 (65.08) | 2.30 (1.63) | 90.7 (72.20) | 0.00 (0.71) | 82.7 (65.38) | 1.33 (1.34) | 83.7 (66.19) | 0.33 (0.88) | 77.7 (61.78) | 1.00 (1.22) | 87.3 (69.18) | 1.83 (1.53) | 83.3 (65.89) | 4.67 (2.27) |
| $T_{10}$ | Untreated control | 70.0 (56.8) | 4.95 (2.33) | 64.00 (53.1) | 7.43 (2.82) | 89.3 | 14.00 (3.31) | 67.26 (55.1) | 15.46 (3.99) | 87.3 (69.1) | 7.00 (2.72) | 79.33 (62.9) | 42.67 (6.56) | 74.0 (59.3) | 13.67 (3.76) | 63.00 (52.5) | 23.00 (4.84) | 81.3 (64.4) | 11.67 (3.49) | 76.67 (61.1) | 15.83 (4.04) |
| | $CD_{0.05}$ | 0.87 | 0.02 | 0.79 | 0.03 | NS | 1.25 | 1.83 | 0.74 | 1.89 | 0.59 | 1.82 | 0.56 | 2.25 | 0.51 | 1.68 | 0.53 | 2.47 | 0.16 | 1.47 | 0.12 |

**G- Per cent seed germination, ID- per cent insect damage* *N.B. figures in parentheses are transformed values*

**Table 4.6: Effect of seed treatments involving entomopathogen and inert dust on per cent seed germination and per cent insect damage in chickpea and cowpea seeds**

| Symbol | Treatments | Chickpea | | | | | | | | | | | | Cowpea | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MPKV, Rahuri | | | | JAU, Junagadh | | | | PDKV, Akola | | | | UAS, Dharwad | | | |
| | | 6 months | | 9 months | | 6 months | | 9 months | | 9 months | | 12 months | | 6 months | | 9 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | *B. bassiana* @ 10g /kg seed | 93.3 (75.02) | 0.67 (1.00) | 91.3 (72.86) | 7.00 (2.72) | 72.3 (58.28) | 2.33 (1.68) | 51.7 (45.94) | 4.67 (2.27) | 85.0 (67.19) | 1.18 (1.30) | 82.7 (65.37) | 1.50 (1.41) | 86.7 (68.63) | 0.00 (0.71) | 83.6 (66.05) | 2.24 (1.66) |
| $T_2$ | *B. bassiana* @ 20g /kg seed | 94.3 (76.21) | 0.33 (0.88) | 93.3 (75.02) | 5.00 (2.34) | 78.3 (62.45) | 0.00 (0.71) | 61.7 (51.73) | 3.00 (1.86) | 85.7 (67.73) | 0.68 (1.08) | 83.3 (65.88) | 1.02 (1.23) | 84.3 (66.61) | 0.00 (0.71) | 81.2 (64.26) | 2.18 (1.64) |
| $T_3$ | *M. anisopliae* @10g /kg seed | 92.3 (73.90) | 1.00 (1.17) | 90.7 (72.19) | 7.67 (2.85) | 72.3 (58.27) | 2.00 (1.58) | 52.3 (46.32) | 4.33 (2.20) | 86.0 (68.01) | 0.84 (1.16) | 83.0 (65.63) | 1.05 (1.24) | 84.0 (66.37) | 0.00 (0.71) | 80.9 (64.05) | 2.17 (1.63) |
| $T_4$ | *M. anisopliae* @20g /kg seed | 93.3 (75.02) | 0.33 (0.88) | 91.3 (72.86) | 6.67 (2.66) | 81.7 (64.67) | 0.00 (0.71) | 61.7 (51.73) | 2.67 (1.77) | 86.3 (68.30) | 0.70 (1.10) | 83.3 (65.89) | 1.01 (1.23) | 85.2 (67.37) | 0.00 (0.71) | 82.1 (64.94) | 2.20 (1.64) |
| $T_5$ | *B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed | 94.7 (76.63) | 0.00 (0.71) | 93.0 (74.65) | 4.00 (2.11) | 75.0 (59.98) | 0.00 (0.71) | 58.3 (49.78) | 3.00 (1.86) | 85.7 (67.73) | 0.68 (1.08) | 85.0 (67.19) | 0.84 (1.16) | 84.6 (66.85) | 0.00 (0.71) | 81.5 (64.48) | 2.18 (1.64) |
| $T_6$ | *B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed | 95.3 (77.51) | 0.00 (0.71) | 94.3 (76.21) | 3.67 (2.03) | 83.3 (65.93) | 0.00 (0.71) | 63.3 (52.72) | 2.00 (1.56) | 85.7 (67.73) | 0.28 (0.88) | 85.3 (67.46) | 0.36 (0.93) | 82.4 (65.19) | 0.00 (0.71) | 79.4 (62.98) | 2.13 (1.62) |
| $T_7$ | *M. anisopliae* @10g /kg seed+ DE @ 5g /kg seed | 94.0 (75.82) | 0.67 (1.05) | 91.7 (73.20) | 4.00 (2.11) | 73.7 (59.13) | 0.00 (0.71) | 53.7 (47.09) | 3.00 (1.86) | 85.7 (67.73) | 0.58 (1.04) | 85.0 (67.19) | 0.69 (1.09) | 82.7 (65.42) | 0.00 (0.71) | 79.7 (63.19) | 2.14 (1.62) |
| $T_8$ | *M. anisopliae* @20g /kg seed+ DE @ 5g /kg seed | 94.3 (76.21) | 0.33 (0.88) | 92.7 (74.27) | 3.00 (1.86) | 87.3 (69.16) | 0.00 (0.71) | 66.7 (54.72) | 1.67 (1.44) | 91.0 (67.73) | 0.25 (0.86) | 85.0 (67.19) | 0.32 (0.90) | 83.3 (65.91) | 0.00 (0.71) | 80.3 (63.63) | 2.15 (1.63) |
| $T_9$ | Deltamethrin@1ppm | 96.0 (78.49) | 0.00 (0.71) | 96.0 (78.49) | 0.00 (0.71) | 88.3 (70.05) | 0.00 (0.71) | 70.3 (57.02) | 1.00 (1.22) | 86.0 (68.00) | 0.28 (0.88) | 84.7 (66.92) | 0.69 (1.09) | 82.7 (65.42) | 0.00 (0.71) | 79.7 (63.19) | 0.25 (0.87) |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_{10}$ | Untreated control | 88.0 (69.7) | 10.33 (3.29) | 83.67 (66.1) | 13.00 (3.67) | 70.3 (57.0) | 5.00 (2.35) | 49.33 (44.6) | 7.33 (2.79) | 70.0 (56.8) | 4.36 (2.20) | 64.00 (53.1) | 5.61 (2.47) | 81.8 (64.8) | 1.82 (1.51) | 65.14 (53.8) | 4.40 (2.19) |
| | $CD_{0.05}$ | 1.52 | 0.50 | 1.42 | 0.46 | 4.32 | 0.09 | 3.01 | 0.42 | 1.14 | 0.05 | 0.96 | 0.05 | 2.15 | 0.12 | 1.69 | 0.23 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.7: Effect of seed treatments involving entomopathogen and inert dust on per cent seed germination and per cent insect damage in black gram and field pea seeds**

| Symbol | Treatments | Black gram | | | | | | | | Field pea | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AAU, Jorhat | | | | PAJANCOA, Karaikal | | | | CSAUAT, Kanpur | | | |
| | | 6 months | | 9 months | | 6 months | | 9 months | | 6 months | | 9 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | *B. bassiana* @ 10g /kg seed | 72.7 (58.46) | 3.17 (1.91) | 62.7 (52.32) | 4.83 (2.31) | 82.0 (64.89) | 0.66 (1.08) | 40 (39.21) | 2.15 (1.63) | 92.7 (74.31) | 0.00 | 91.0 (72.53) | 0.00 (0.71) |
| $T_2$ | *B. bassiana* @ 20g /kg seed | 71.3 (57.61) | 3.33 (1.96) | 61.3 (51.53) | 4.33 (2.20) | 84.5 (65.73) | 0.52 (1.01) | 44.5 (40.96) | 1.86 (1.54) | 90.3 (71.89) | 0.00 | 89.0 (70.64) | 0.00 (0.71) |
| $T_3$ | *M. anisopliae* @10g /kg seed | 72.7 (58.46) | 2.33 (1.68) | 63.3 (52.71) | 3.33 (1.96) | 84.0 (66.41) | 0.45 (0.97) | 51.5 (45.27) | 1.98 (1.57) | 90.0 (71.55) | 0.00 | 88.0 (69.71) | 0.00 (0.71) |
| $T_4$ | *M. anisopliae* @20g /kg seed | 70.7 (57.19) | 2.67 (1.78) | 67.3 (55.12) | 3.17 (1.91) | 86.0 (67.60) | 0.41 (0.96) | 53.5 (46.13) | 1.15 (1.28) | 89.3 (70.94) | 0.00 | 87.3 (69.13) | 0.00 (0.71) |
| $T_5$ | *B. bassiana* @ 10g /kg seed +DE @ 5g /kg seed | 78.7 (62.47) | 1.83 (1.53) | 70.7 (57.19) | 3.00 (1.87) | 84.5 (68.07) | 0.67 (1.08) | 70.0 (54.69) | 1.78 (1.51) | 90.7 (72.26) | 0.00 | 89.3 (70.94) | 0.00 (0.71) |
| $T_6$ | *B. bassiana* @ 20g /kg seed +DE @ 5g /kg seed | 83.3 (65.89) | 0.83 (1.15) | 75.3 (60.20) | 2.00 (1.58) | 88.0 (68.53) | 0.59 (1.04) | 76.0 (59.68) | 0.98 (1.22) | 92.3 (73.95) | 0.00 | 88.7 (70.33) | 0.00 (0.71) |
| $T_7$ | *M. anisopliae* @10g /kg seed+ DE @ 5g /kg seed | 75.3 (60.20) | 2.33 (1.68) | 71.3 (57.61) | 3.17 (1.91) | 87.0 (68.91) | 0.44 (0.97) | 72.0 (58.69) | 1.56 (1.44) | 89.0 (70.61) | 0.00 | 87.0 (68.85) | 0.00 (0.71) |
| $T_8$ | *M. anisopliae* @20g /kg seed+ DE @ 5g /kg seed | 84.7 (66.93) | 0.75 (1.11) | 74.7 (59.76) | 1.83 (1.53) | 89.0 (71.12) | 0.37 (0.93) | 79.0 (61.74) | 0.84 (1.16) | 91.7 (73.23) | 0.00 | 88.0 (69.74) | 0.00 (0.71) |
| $T_9$ | Deltamethrin@1ppm | 85.3 (67.46) | 0.08 (0.76) | 79.3 (62.94) | 0.33 (0.91) | 86.5 (68.45) | 0.38 (0.94) | 69.0 (58.08) | 1.01 (1.23) | 92.0 (73.62) | 0.00 | 86.0 (68.03) | 0.00 (0.71) |
| $T_{10}$ | Untreated control | 68.0 (55.5) | 10.17 (3.27) | 39.33 (38.8) | 23.33 (4.88) | 78 (63.51) | 2.04 (1.59) | 28 (36.87) | 4.02 (2.13) | 88.3 (70.0) | 0.00 | 47.33 (43.4) | 16.67 (4.12) |
| | $CD_{0.05}$ | 1.31 | 0.18 | 1.23 | 0.24 | 2.68 | 0.03 | 2.09 | 0.02 | 2.60 | - | 2.48 | 0.26 |

**G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values*

❖ **Studies on efficacy of plant based neutral silica on storage insects and seed quality during storage under ambient condition**

Three different doses of neutral silica (@2500ppm, 3000ppm and 3500ppm) were evaluated against storage pests of cereals and pulses. There were variations in results due to differences in seed materials, ambient conditions or prevailing insect pests, their density and proximity to stored material. Results revealed that all the treatments involving neutral silica were significantly better than control with respect to insect damage. It has also been observed that neutral silica @ 3500 ppm was significantly better than diatomaceous earth @ 5g /kg seed with respect to insect damage in most of crops and provided safe storage (restricted insect damage within permissible limit and maintained seed germination above IMSCS) of wheat, paddy, pearl millet, green gram, black gram, cowpea, pigeon pea, chickpea and field pea up to 6-9 months at most of the centres.

**Table 4.8: Effective seed treatments and storage periods for different crops and at various centres**

| Crop | Centre | Safe period of storage (months) | Effective treatments |
|---|---|---|---|
| Wheat | RPCAU, Dholi | 9 | Neutral silica @ 3500 ppm (ID-nil) |
| | IISS, Mau | 6 | Neutral silica @ 3500 ppm (ID-1.1%) |
| Paddy | AAU, Jorhat | 6 | Neutral silica @ 3500 ppm (ID-0.42%) |
| | OUA&T, Bhubaneswar | 6 | Neutral silica @ 3000 ppm (ID-nil)<br>Neutral silica @ 3500 ppm (ID-nil) |
| | TNAU, Coimbatore | 6 | Neutral silica @ 2500 ppm (ID-nil)<br>Neutral silica @ 3000 ppm (ID-nil)<br>Neutral silica @ 3500 ppm (ID-nil) |
| Pearl millet | SKNAU, Jobner | 6 | Neutral silica @ 3500 ppm (ID-nil) |
| | JAU, Junagadh | - | Deltamethrin @ 1 ppm (ID -1.0%)<br>Neutral silica @ 3500 ppm (ID 2.0%) |
| Black gram | UAS, Raichur | 12 | All seed treatments (ID-Nil) |
| | PAJANCOA, Karaikal | 6 | Neutral silica @ 2500 ppm (ID-0.96)<br>Neutral silica @ 3000 ppm (ID-0.59)<br>Neutral silica @ 3500 ppm (ID-nil) |
| | UAS, Bangalore | - | Deltamethrin @1ppm (ID-1.43%)<br>Neutral silica @3500ppm (ID-1.27%) |
| Cowpea | PDKV, Akola | 12 | Neutral silica @ 3000 ppm (ID-0.75%)<br>Neutral silica @ 3500 ppm (ID-0.38%) |
| | UAS, Dharwad | 6 | Neutral silica @3500ppm (ID-1.0%) |
| | IIVR, Varanasi | 6 | Neutral silica @ 2500 ppm (ID-0.92%)<br>Neutral silica @ 3000 ppm (ID-0.67%)<br>Neutral silica @ 3500 ppm (ID-0.58%) |
| Chickpea | MPKV, Rahuri | 6 | All seed treatments (ID-nil) |
| | JAU, Junagadh | 6 | Neutral silica @ 3500 ppm (ID-1.33%) |
| Green gram | AAU, Jorhat | 6 | Neutral silica @ 3500 ppm (ID-0.50%) |
| | CSAUAT, Kanpur | 6 | Neutral silica @2500ppm (ID-nil) |

| | | | |
|---|---|---|---|
| | | | Neutral silica @3000ppm (ID-nil)<br>Neutral silica @3500ppm (ID-nil) |
| | UAS, Bangalore | 3 | Deltamethrin @1ppm (ID-1.29%)<br>Neutral silica @3500ppm (ID-1.40%) |
| Pigeon pea | PDKV, Akola | 12 | Neutral silica @ 3500 ppm (ID-0.36%) |
| Field pea | RPCAU, Dholi | 9 | Neutral silica @3000ppm (ID-0.47%)<br>Neutral silica @3500ppm (ID-nil)<br>DE@5g/kg seed (ID-0.40%) |
| | CSAUAT, Kanpur | 9 | Neutral silica @2500ppm (ID-nil)<br>Neutral silica @3000ppm (ID-nil)<br>Neutral silica @3500ppm (ID-nil) |

**Table 4.9: Effect of seed treatments on per cent seed germination and per cent insect damage in paddy seeds**

| Symbol | Treatments | Paddy | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AAU, Jorhat | | | | TNAU Coimbatore | | | | OUAT, Bhubaneswar | | | |
| | | 6 months | | 9 months | | 3 months | | 6 months | | 3 months | | 6 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | Neutral silica @ 2500 ppm | 82.3 (65.12) | 2.00 (1.58) | 76.33 (60.87) | 3.33 (1.95) | 86.0 | 0.00 (0.71) | 85.0 (67.20) | 0.00 (0.71) | 92.0 (73.56) | 0.00 (0.71) | 86.0 (68.03) | 0.33 (0.88) |
| $T_2$ | Neutral silica @ 3000 ppm | 84.3 (66.66) | 1.17 (1.29) | 78.00 (62.01) | 1.83 (1.53) | 85.5 | 0.00 (0.71) | 84.5 (66.82) | 0.00 (0.71) | 91.7 (73.24) | 0.00 (0.71) | 86.7 (68.56) | 0.00 (0.71) |
| $T_3$ | Neutral silica @ 3500 ppm | 87.3 (69.13) | 0.42 (0.96) | 82.33 (65.12) | 0.67 (1.07) | 85.0 | 0.00 (0.71) | 84.5 (66.80) | 0.00 (0.71) | 91.3 (72.87) | 0.00 (0.71) | 86.3 (68.30) | 0.00 (0.71) |
| $T_4$ | Diatomaceous earth @ 5g /kg seed | 80.3 (63.65) | 1.00 (1.22) | 75.33 (60.20) | 1.67 (1.47) | 85.5 | 0.00 (0.71) | 85.0 (67.20) | 0.00 (0.71) | 90.0 (71.59) | 0.00 (0.71) | 85.0 (67.20) | 3.33 (1.93) |
| $T_5$ | Deltamethrin @ 1 ppm | 88.3 (70.00) | 0.04 (0.73) | 83.33 (65.88) | 0.08 (0.76) | 84.5 | 0.75 (1.11) | 83.0 (65.64) | 2.38 (01.69) | 91.3 (72.85) | 0.00 (0.71) | 85.7 (67.75) | 0.67 (1.05) |
| $T_6$ | Untreated control | 71.0 (57.40) | 5.00 (2.34) | 62.33 (52.12) | 10.33 (3.29) | 83.0 | 3.88 (2.09) | 80.5 (63.79) | 7.13 (02.76) | 87.7 (69.43) | 11.33 (3.44) | 82.0 (64.87) | 15.33 (3.97) |
| | $CD_{0.05}$ | 0.88 | 0.17 | 0.95 | 0.23 | NS | 0.10 | 1.64 | 0.13 | 2.38 | 0.16 | 1.88 | 0.47 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.10: Effect of seed treatments on per cent seed germination and per cent insect damage in wheat and pearl millet seeds**

| *Symbol* | *Treatments* | wheat | | | | | | | | pearl millet | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NISST, Mau | | | | RPCAU, Dholi | | | | SKNAU, Jobner | | | | JAU, Junagadh | | | |
| | | 3 months | | 6 months | | 6 months | | 9 months | | 3 months | | 6 months | | 3 months | | | 6 months |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | Neutral silica @ 2500 ppm | 92.0 (73.60) | 0.05 (0.74) | 83.5 (66.02) | 1.38 (1.37) | 86.7 (68.56) | 0.27 (0.86) | 81.33 (64.38) | 1.73 (1.47) | 88.0 (69.75) | 0.00 | 85.7 (67.77) | 0.33 (0.88) | 80.0 (63.41) | 4.67 (2.27) | 75.0 (60.05) | 5.00 (2.35) |
| $T_2$ | Neutral silica @ 3000 ppm | 92.0 (73.60) | 0.03 (0.73) | 84.8 (67.00) | 1.16 (1.29) | 88.0 (69.74) | 0.00 (0.71) | 82.67 (65.38) | 0.07 (0.75) | 91.0 (72.53) | 0.00 | 88.0 (69.82) | 0.33 (0.88) | 81.7 (64.67) | 3.33 (1.95) | 78.0 (62.00) | 4.00 (2.12) |
| $T_3$ | Neutral silica @ 3500 ppm | 91.3 (72.97) | 0.01 (0.71) | 87.3 (69.06) | 1.11 (1.27) | 90.0 (71.55) | 0.00 (0.71) | 87.67 (69.43) | 0.00 (0.71) | 92.3 (73.95) | 0.00 | 91.0 (72.70) | 0.00 (0.71) | 85.0 (67.38) | 2.00 (1.58) | 78.7 (62.47) | 2.33 (1.68) |
| $T_4$ | Diatomaceous earth @ 5g /kg seed | 90.7 (72.20) | 0.13 (0.79) | 83.5 (66.04) | 1.23 (1.32) | 90.0 (71.55) | 0.00 (0.71) | 81.33 (64.38) | 0.67 (1.06) | 88.0 (69.71) | 0.00 | 83.0 (65.66) | 0.67 (1.05) | 75.7 (60.44) | 5.67 (2.48) | 70.7 (57.19) | 6.67 (2.68) |
| $T_5$ | Deltamethrin @ 1 ppm | 92.0 (73.60) | 0.00 (0.71) | 81.8 (64.69) | 1.13 (1.28) | 88.7 (70.33) | 0.07 (0.75) | 80.33 (63.66) | 1.60 (1.43) | 88.3 (70.03) | 0.00 | 89.3 (70.94) | 0.00 (0.71) | 88.0 (70.52) | 1.00 (1.22) | 81.7 (64.67) | 1.67 (1.46) |
| $T_6$ | Untreated control | 81.0 (64.17) | 0.63 (1.06) | 74.3 (59.53) | 6.25 (2.60) | 78.7 (62.47) | 11.60 (3.48) | 72.33 (58.24) | 16.93 (4.17) | 86.7 (68.58) | 0.33 | 82.7 (65.38) | 6.67 (2.68) | 74.0 (59.32) | 8.67 (3.02) | 70.0 (56.77) | 9.67 (3.19) |
| | $CD_{0.05}$ | 2.70 | 0.06 | 2.02 | 0.08 | 1.86 | 0.15 | 1.65 | 0.40 | *2.44* | *NS* | *4.03* | *0.38* | 6.65 | 0.21 | 2.99 | 0.22 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.11: Effect of insecticidal seed treatment on per cent seed germination and per cent insect damage in Pigeon pea and green gram seeds**

| | | Pigeon pea | | | | Green gram | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Symbol | Treatments | PDKV, Akola | | | | UAS, Bangalore | | | | AAU, Jorhat | | | | CSAUAT, Kanpur | | | |
| | | 9 months | | 12 months | | 3 months | | 6 months | | 6 months | | 9 months | | 6 months | | 9 months | |
| | | G | ID | G | ID | G | ID | G | ID | *G* | ID | G | ID | G | ID | G | ID |
| $T_1$ | Neutral silica @ 2500 ppm | 83.0 (65.63) | 1.06 (01.25) | 80.67 (63.89) | 1.59 (01.45) | 67.0 (54.97) | 7.21 (2.78) | 52.0 (46.13) | 15.79 (4.04) | 72.7 (58.46) | 2.33 (1.68) | 67.3 (55.12) | 3.50 (2.00) | 90.3 (71.92) | 0.00 (0.71) | 65.7 (54.11) | 11.33 (3.41) |
| $T_2$ | Neutral silica @ 3000 ppm | 83.7 (66.14) | 0.58 (01.04) | 81.33 (64.38) | 1.01 (01.23) | 72.7 (58.46) | 4.30 (2.19) | 61.7 (51.73) | 11.37 (3.44) | 76.7 (61.10) | 1.33 (1.35) | 69.3 (56.35) | 2.67 (1.78) | 91.7 (73.23) | 0.00 (0.71) | 75.7 (60.45) | 10.00 (3.23) |
| $T_3$ | Neutral silica @ 3500 ppm | 86.3 (68.28) | 0.24 (00.86) | 82.33 (65.12) | 0.36 (00.92) | 78.3 (62.24) | 1.40 (1.37) | 73.7 (59.11) | 3.70 (2.04) | 80.0 (63.43) | 0.50 (1.00) | 74.7 (59.76) | 1.33 (1.35) | 92.0 (73.62) | 0.00 (0.71) | 77.7 (61.80) | 7.67 (2.84) |
| $T_4$ | Diatomaceous earth @ 5g /kg seed | 83.3 (65.88) | 0.67 (01.08) | 80.33 (63.65) | 1.03 (01.24) | 73.0 (58.69) | 3.42 (1.98) | 53.7 (47.09) | 9.53 (3.17) | 71.3 (57.61) | 2.67 (1.78) | 68.0 (55.53) | 3.33 (1.96) | 91.3 (72.89) | 0.00 (0.71) | 78.0 (62.03) | 10.67 (3.34) |
| $T_5$ | Deltamethrin @ 1 ppm | 84.3 (66.66) | 0.66 (01.08) | 82.00 (64.88) | 1.03 (01.24) | 86.3 (68.37) | 1.29 (1.34) | 81.3 (64.47) | 1.43 (1.39) | 81.3 (64.38) | 0.08 (0.76) | 80.7 (63.90) | 0.25 (0.87) | 89.0 (70.65) | 0.00 (0.71) | 77.0 (61.34) | 11.00 (3.38) |
| $T_6$ | Untreated control | 73.7 (59.10) | 3.22 (01.93) | 68.00 (55.53) | 5.05 (02.36) | 54.3 (47.50) | 10.21 (3.27) | 43.0 (40.95) | 24.57 (5.00) | 52.0 (46.13) | 63.33 (7.99) | 30.0 (33.19) | 78.33 (8.88) | 64.7 (54.21) | 20.33 (4.56) | 46.7 (43.06) | 29.33 (5.45) |
| | $CD_{0.05}$ | *0.91* | *0.05* | *0.93* | *0.02* | 5.32 | 0.23 | 3.44 | 0.25 | 1.75 | 0.19 | 1.68 | 0.19 | 11.91 | 0.17 | 4.29 | 0.66 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.12: Effect of insecticidal seed treatment on per cent seed germination and per cent insect damage in field pea and cowpea seeds**

| Symbol | Treatments | Field pea | | | | | | | | Cowpea | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | RPCAU, Dholi | | | | CSAUAT, Kanpur | | | | PDKV Akola | | | | UAS, Dharwad | | | | IIVR, Varanasi | | | |
| | | 6 months | | 9 months | | 6 months | | 9 months | | 9 months | | 12 months | | 6 months | | 9 months | | 3 months | | 6 months | |
| | | *G* | ID | G | ID | *G* | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | Neutral silica @ 2500 ppm | 87.7 (69.42) | 0.00 (0.71) | 80.67 (63.89) | 2.27 (01.66) | 92.0 (73.56) | 0.00 | 86.3 (68.31) | 0.00 (0.71) | 81.0 (64.14) | 1.11 (01.27) | 80.00 (63.41) | 1.78 (01.51) | 83.6 (66.17) | 3.33 (1.85) | 75.0 | 3.43 (1.98) | 86.7 | 0.67 (1.08) | 83.3 | 0.92 (1.19) |
| $T_2$ | Neutral silica @ 3000 ppm | 87.7 (69.43) | 0.00 (0.71) | 82.67 (65.38) | 0.47 (00.97) | 92.3 (73.95) | 0.00 | 82.3 (65.14) | 0.00 (0.71) | 82.0 (64.88) | 0.47 (00.98) | 78.67 (62.47) | 0.75 (01.12) | 86.5 (68.70) | 2.00 (1.43) | 77.7 | 5.17 (2.35) | 86.7 | 0.58 (1.04) | 83.3 | 0.67 (1.08) |
| $T_3$ | Neutral silica @ 3500 ppm | 89.7 (71.22) | 0.00 (0.71) | 86.67 (68.56) | 0.00 (0.71) | 91.0 (72.56) | 0.00 | 81.0 (64.17) | 0.00 (0.71) | 82.3 (65.12) | 0.22 (00.85) | 80.33 (63.65) | 0.38 (00.94) | 87.8 (69.61) | 1.00 (1.17) | 78.8 | 3.77 (1.99) | 88.3 | 0.33 (0.90) | 81.7 | 0.58 (1.04) |
| $T_4$ | Diatomaceous earth @ 5g /kg seed | 90.0 (71.54) | 0.00 (0.71) | 86.67 (68.56) | 0.40 (0.91) | 93.7 (75.40) | 0.00 | 91.0 (72.62) | 0.00 (0.71) | 80.3 (63.65) | 1.28 (01.33) | 78.33 (62.24) | 2.05 (01.60) | 86.5 (68.53) | 2.33 (1.57) | 74.7 | 3.31 (1.89) | 90.0 | 0.58 (1.04) | 85.0 | 0.75 (1.12) |
| $T_5$ | Deltamethrin @ 1 ppm | 88.7 (70.33) | 0.00 (0.71) | 82.33 (65.12) | 1.27 (1.32) | 91.7 (73.23) | 0.00 | 83.0 (65.67) | 1.67 (01.39) | 82.0 (64.87) | 0.51 (01.00) | 79.33 (62.94) | 0.81 (01.14) | 88.8 (70.55) | 0.33 (0.88) | 79.7 | 1.56 (1.36) | 90.0 | 0.17 (0.81) | 88.3 | 0.33 (0.90) |
| $T_6$ | Untreated control | 80.3 (63.65) | 9.07 (3.09) | 72.67 (58.47) | 15.93 (4.05) | 89.0 (70.65) | 0.00 | 70.0 (56.77) | 18.00 (04.29) | 73.0 (58.67) | 3.61 (02.03) | 69.33 (56.35) | 4.33 (02.20) | 77.3 (61.56) | 19.63 (4.38) | 69.4 | 28.33 (5.32) | 88.3 | 2.75 (1.80) | 81.7 | 5.58 (2.46) |
| | $CD_{0.05}$ | 2.78 | 0.15 | 3.08 | 0.50 | 2.63 | - | 3.37 | 0.51 | 0.99 | 0.04 | 0.65 | 0.05 | 5.62 | 1.37 | NS | 1.09 | NS | 0.19 | NS | 0.21 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.13: Effect of insecticidal seed treatment on per cent seed germination and per cent insect damage in black gram and chickpea seeds**

| Symbol | *Treatments* | Black gram | | | | | | | | | | | | chickpea | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | UAS, Raichur | | | | PAJANCOA, Karaikal | | | | UAS, Bangalore | | | | JAU, Junagadh | | | | MPKV, Rahuri | | | |
| | | 12 months | | 15 months | | 3 months | | 6 months | | 3 months | | 6 months | | 3 months | | 6 months | | 6 months | | | 9 months |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | Neutral silica @ 2500 ppm | 90.3 | 0.00 (0.71) | 87.7 (69.43) | 2.00 (1.56) | 86.5 68.49) | 0.52 1.01) | 81.5 64.52) | 0.96 (1.21) | 67.7 (55.36) | 5.97 (2.54) | 44.3 (41.72) | 11.86 (3.51) | 96.7 | 2.00 (1.58) | 91.0 72.53) | 3.00 (1.87) | 91.8 (73.35) | 0.00 (0.71) | 90.8 (72.32) | 2.75 (1.76) |
| $T_2$ | Neutral silica @ 3000 ppm | 91.7 | 0.00 (0.71) | 88.0 (69.75) | 1.25 (1.27) | 89.0 70.70) | 0.29 0.89) | 84.0 66.46) | 0.59 (1.05) | 73.3 (58.90) | 3.53 (2.00) | 51.3 (45.75) | 9.98 (3.23) | 96.7 | 1.67 (1.46) | 94.0 78.35) | 2.33 (1.68) | 94.5 (76.52) | 0.00 (0.71) | 93.0 (74.75) | 1.75 (1.48) |
| $T_3$ | Neutral silica @ 3500 ppm | 93.3 | 0.00 (0.71) | 90.7 (72.19) | 0.25 (0.84) | 92.5 74.17) | 0.00 0.71) | 88.5 70.20) | 0.00 (0.71) | 81.3 (64.38) | 1.27 (1.33) | 70.7 (57.20) | 2.57 (1.75) | 97.7 | 0.33 (0.88) | 94.7 76.67) | 1.33 (1.34) | 95.8 (78.16) | 0.00 (0.71) | 94.5 (76.48) | 1.25 (1.26) |
| $T_4$ | Diatomaceous earth @ 5g /kg seed | 91.3 | 0.00 (0.71) | 87.7 (69.41) | 0.50 (0.97) | 88.0 69.74) | 0.15 0.81) | 84.0 66.46) | 0.22 (0.85) | 72.0 (58.06) | 2.00 (1.57) | 57.3 (49.21) | 8.36 (2.98) | 88.7 | 4.33 (2.20) | 83.7 66.15) | 5.00 (2.35) | 94.0 (75.95) | 0.00 (0.71) | 93.0 (74.75) | 0.00 (0.71) |
| $T_5$ | Deltamethrin @ 1 ppm | 90.0 | 0.00 (0.71) | 87.0 (68.88) | 2.25 (1.65) | 89.5 71.12) | 0.00 0.71) | 86.5 68.45) | 0.00 (0.71) | 88.0 (69.77) | 1.43 (1.39) | 80.0 (63.43) | 1.73 (1.49) | 98.3 | 0.00 (0.71) | 95.7 77.97) | 0.33 (0.88) | 96.3 (78.87) | 0.00 (0.71) | 92.5 (74.22) | 0.00 (0.71) |
| $T_6$ | Untreated control | 88.7 | 2.50 (1.73) | 80.0 (63.43) | 4.75 (2.29) | 84.5 66.82) | 0.94 1.20) | 76.0 60.65) | 1.92 (1.56) | 42.0 (40.38) | 9.09 (3.10) | 38.0 (38.03) | 24.80 (5.03) | 85.0 | 9.33 (3.13) | 83.3 65.89) | 13.33 (3.70) | 90.0 (71.57) | 10.75 (3.35) | 86.8 (68.66) | 24.50 (4.99) |
| | $CD_{0.05}$ | NS | 0.10 | 2.24 | 0.40 | 2.86 | 0.02 | 2.64 | 0.02 | 3.46 | 0.26 | 3.95 | 0.31 | NS | 0.31 | 7.58 | 0.41 | 2.78 | 0.15 | 3.08 | 0.50 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

❖ **Studies on the effect of insecticidal seed treatment on seed quality during storage under ambient condition.**

Two newer insecticides i.e. broflanilide (first compound under the new IRAC group 30 which comes under Category-IV (very low toxicity) of EPA toxicity category of insecticides) and dinotefuran (Neonicotinoid, IRAC group 4A, Category-III) having low toxicity towards mammals and other non-target organisms were tested for their efficacy against storage insects. Both of these insecticides were tested using three different doses i.e. @ 1ppm, 2ppm & 3ppm along with emamectin benzoate @2ppm and deltamethrin@1ppm. All those treatment(s) where seed germination was maintained above IMSCS as well as insect damage was within permissible limit under IMSCS i.e. 1% for maize and pulses and 0.5% for other crop seeds, were considered as safe and effective for seed.

The results revealed that newer insecticides were found at par with deltamethrin (Decis 2.8 EC) @1.0ppm and emamectin benzoate @2ppm or even better in some of the centres. Among various concentrations of newer insecticides, broflanilide @3ppm provided control of storage insects infesting wheat, paddy, pearl millet, sorghum, green gram, pigeonpea, chickpea, cowpea, black gram, horse gram and field pea under different agro-climatic conditions up to 9-12 months without impairing the seed viability.

**Table 4.14: Effective seed treatment insecticide molecules and storage periods for different crops and at various centres**

| *Crop* | *Centre* | *Safe period of storage (months)* | *Effective treatments* |
|---|---|---|---|
| Wheat | CSAUA&T, Kanpur | 9 | All insecticidal treatments |
| | IISS, Mau | 6 | Broflanilide @2&3ppm, dinotefuran @2&3ppm, Emamectin benzoate@2ppm, deltamethirn @1ppm |
| Paddy | AAU, Jorhat | 9 | Broflanilide@3ppm, deltamethirn @1ppm |
| | OUAT, Bhubaneswar | 6 | Broflanilide @2&3ppm, dinotefuran @2&3ppm, Emamectin benzoate@2ppm, |
| Pearl millet | SKNAU, Jobner | 9 | Dinotefuran @3ppm, Broflanilide @3ppm, |
| | JAU, Junagadh | 6 | Broflanilide @3ppm, deltamethirn @1ppm |
| Sorghum | MPKV, Rahuri | 12 | Broflanilide @3ppm, dinotefuran @3ppm, deltamethirn @1ppm |
| | PDKV, Akola | 12 | Broflanilide @2&3ppm, dinotefuran @3ppm |
| Pigeon pea | PDKV, Akola | 12 | Broflanilide @2&3ppm, dinotefuran @2&3ppm |
| Cow pea | UAS, Dharwad | 9 | All seed treatments |
| | UAS, Bangalore | - | None of the treatments |
| Green gram | TNAU, Coimbatore | 12 | Broflanilide @3ppm |
| | UAS, Raichur | 15 | All seed treatments |
| | CSAUAT, Kanpur | 9 | All seed treatments |
| | OUAT, Bhubaneswar | 6 | All seed treatments |
| Black gram | TNAU, Coimbatore | 12 | Broflanilide @2ppm &3ppm |

| | | | |
|---|---|---|---|
| | PAJANCOA & RI, Karaikal | 6 | All seed treatments |
| | UAS, Bangalore | 3 | Broflanilide @3ppm |
| Chick pea | MPKV, Rahuri | 12 | Broflanilide @3ppm, dinotefuran @3ppm, Emamectin benzoat@2ppm, deltamethirn @1ppm |
| Field pea | CSAUAT, Kanpur | 9 | All seed treatments |
| Horse gram | IISS-RS, Bangalore | 12 | All seed treatments |
| Groundnut | JAU, Junagadh | 9 | Broflanilide @1, 2 & 3ppm (ID-Nil), emamectin benzoat@2ppm (ID-Nil), deltamethirn @1ppm (ID-Nil) |
| Vegetable pea | IIVR, Varanasi | 9 | All seed treatments (ID 0.08-0.58%) |

**Table 4.15: Effect of insecticidal seed treatment on per cent seed germination and per cent insect damage in wheat and paddy seeds**

| Symbol | Treatments | Wheat | | | | | | | | Paddy | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CSAUAT, Kanpur | | | | IISS, Mau | | | | AAU, Jorhat | | | | OUAT, Bhubaneswar | | | |
| | | 9 months | | 12 months | | 3 months | | 6 months | | 9 months | | 12 months | | 3 months | | 6 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | Broflanilide @ 1 ppm (300 SC @3.33 mg /kg seed) | 87.3 (69.15) | 0.0 (0.71) | 61.7 (51.73) | 0.0 (0.71) | 88.3 (70.03) | 0.0 (0.71) | 84.7 (66.94) | 0.13 (00.80) | 73.3 (58.89) | 1.20 (1.29) | 67.3 (55.12) | 2.83 (1.82) | 91.0 (72.53) | 0.33 (0.88) | 86.0 (68.03) | 0.67 (1.05) |
| $T_2$ | Broflanilide @ 2 ppm (300 SC @6.66 mg /kg seed) | 90.0 (71.54) | 0.0 (0.71) | 72.0 (58.05) | 0.0 (0.71) | 91.7 (73.39) | 0.0 (0.71) | 86.3 (68.28) | 0.0 (0.71) | 74.7 (59.76) | 0.70 (1.07) | 68.3 (55.73) | 2.17 (1.63) | 89.7 (71.23) | 0.00 (0.71) | 85.7 (67.77) | 0.33 (0.88) |
| $T_3$ | Broflanilide @ 3 ppm (300 SC @9.99 mg /kg seed) | 89.7 (71.23) | 0.0 (0.71) | 68.7 (55.94) | 0.0 (0.71) | 91.0 (72.53) | 0.0 (0.71) | 86.7 (68.60) | 0.0 (0.71) | 81.3 (64.38) | 0.20 (0.81) | 75.0 (59.98) | 0.42 (0.96) | 90.3 (71.92) | 0.00 (0.71) | 86.3 (68.28) | 0.00 (0.71) |
| $T_4$ | Dinotefuran @ 1 ppm (20SG @5 mg/kg seed) | 89.0 (70.61) | 0.0 (0.71) | 66.0 (54.31) | 2.33 (1.54) | 84.3 (66.70) | 0.0 (0.71) | 83.7 (66.16) | 0.20 (0.84) | 74.7 (59.76) | 2.70 (1.78) | 63.3 (52.71) | 2.83 (1.82) | 90.0 (71.55) | 0.33 (0.88) | 85.0 (67.22) | 1.00 (1.22) |
| $T_5$ | Dinotefuran @ 2 ppm (20SG @10 mg/kg seed) | 89.7 (71.23) | 0.0 (0.71) | 69.0 (56.15) | 0.0 (.71) | 90.7 (72.21) | 0.0 (0.71) | 85.0 (67.20) | 0.07 (0.75) | 74.7 (59.76) | 2.50 (1.73) | 64.3 (53.31) | 2.67 (1.78) | 90.3 (71.92) | 0.00 (0.71) | 86.0 (68.03) | 0.33 (0.88) |
| $T_6$ | Dinotefuran @ 3 ppm (20SG @15 mg/kg seed) | 90.7 (72.21) | 0.0 (0.71) | 84.7 (66.97) | 0.0 (0.71) | 90.0 (71.54) | 0.0 (0.71) | 86.3 (68.31) | 0.03 (0.73) | 78.0 (62.02) | 1.80 (1.53) | 65.0 (53.71) | 2.17 (1.63) | 91.0 (72.53) | 0.00 (0.71) | 85.7 (67.75) | 0.00 (0.71) |
| $T_7$ | Emamectin benzoate @2ppm (@40.0 mg/kg seed) | 87.0 (68.85) | 0.0 (0.71) | 62.3 (52.13) | 2.00 (1.47) | 89.3 (70.93) | 0.01 (0.72) | 89.0 (70.61) | 0.19 (0.83) | 72.0 (58.04) | 3.20 (1.91) | 59.3 (50.36) | 3.83 (2.08) | 89.7 (71.25) | 0.00 (0.71) | 86.3 (68.28) | 0.00 (0.71) |
| $T_8$ | Deltamethrin @ 1ppm (2.8EC @0.04 ml/kg of seed) | 85.0 (67.20) | 0.0 (0.71) | 55.3 (48.04) | 3.00 (1.86) | 91.3 (72.87) | 0.0 (0.71) | 83.7 (66.14) | 0.12 (0.79) | 82.7 (65.38) | 0.10 (0.76) | 74.7 (59.76) | 0.25 (0.87) | 90.7 (72.26) | 1.00 (1.17) | 85.7 (67.75) | 1.33 (1.34) |
| T9 | Untreated control | 82.0 (64.94) | 8.67 (3.02) | 22.0 (27.93) | 57.00 (7.58) | 76.3 (61.03) | 0.75 (1.11) | 63.7 (52.94) | 9.50 (3.15) | 64.7 (53.51) | 12.30 (3.58) | 40.0 (39.21) | 33.33 (5.81) | 86.0 (68.01) | 15.67 (4.01) | 79.7 (63.18) | 15.33 (3.98) |
| | $CD_{0.05}$ | 2.06 | 0.19 | 2.42 | 0.67 | 3.77 | 0.06 | 2.74 | 0.22 | 1.60 | 0.15 | 1.15 | 0.20 | 2.48 | 0.42 | 2.83 | 0.33 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.16: Effect of insecticidal seed treatment on per cent seed germination and per cent insect damage in pearl millet and sorghum seeds**

| Symbol | Treatments | Pearl millet | | | | | | | | Sorghum | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SKNAU, Jobner | | | | JAU, Junagadh | | | | PDKV, Akola | | | | MPKV, Rahuri | | | |
| | | 9 months | | 12 months | | 6 months | | 9 months | | 9 months | | 12 months | | 9 months | | 12 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | Broflanilide @ 1 ppm (300 SC @3.33 mg /kg seed) | 81.0 (64.14) | 1.33 (1.27) | 75.3 (60.20) | 5.33 (2.41) | 77.7 (61.80) | 0.0 (0.71) | 66.0 (54.32) | 0.0 (0.71) | 81.7 (64.62) | 0.78 (1.13) | 79.7 (63.17) | 0.94 (1.20) | 90.7 (72.26) | 4.00 (2.11) | 80.7 (63.90) | 8.00 (2.90) |
| $T_2$ | Broflanilide @ 2 ppm (300 SC @6.66 mg /kg seed) | 81.7 (64.63) | 1.33 (1.34) | 76.7 (61.09) | 4.33 (2.18) | 71.3 (57.61) | 0.0 (0.71) | 56.7 (48.81) | 0.0 (0.71) | 81.0 (64.13) | 0.42 (0.96) | 79.0 (62.70) | 0.50 (1.00) | 92.0 (73.56) | 0.0 (0.71) | 83.0 (65.65) | 3.00 (1.86) |
| $T_3$ | Broflanilide @ 3 ppm (300 SC @9.99 mg /kg seed) | 85.0 (67.21) | 0.67 (1.05) | 79.7 (63.18) | 1.00 (1.22) | 75.7 (60.42) | 0.0 (0.71) | 62.3 (52.12) | 0.0 (0.71) | 82.7 (65.37) | 0.12 (0.79) | 80.3 (63.65) | 0.29 (0.89) | 93.0 (74.65) | 0.0 (0.71) | 86.0 (68.06) | 0.0 (0.71) |
| $T_4$ | Dinotefuran @ 1 ppm (20SG @5 mg/kg seed) | 79.3 (62.94) | 1.33 (1.34) | 74.7 (59.76) | 3.33 (1.94) | 73.7 (59.11) | 35.0 (5.95) | 61.7 (51.72) | 38.33 (06.23) | 84.3 (66.66) | 0.99 (1.22) | 80.7 (63.89) | 1.22 (1.31) | 89.0 (70.61) | 5.00 (2.34) | 80.3 (63.65) | 12.67 (3.62) |
| $T_5$ | Dinotefuran @ 2 ppm (20SG @10 mg/kg seed) | 81.0 (64.15) | 1.00 (1.17) | 76.0 (60.65) | 2.00 (1.56) | 74.3 (59.56) | 30.0 (5.51) | 62.3 (52.12) | 31.67 (05.67) | 84.7 (66.93) | 0.81 (1.14) | 80.3 (63.65) | 0.99 (1.22) | 90.0 (71.55) | 0.0 (0.71) | 81.7 (64.63) | 4.33 (2.09) |
| $T_6$ | Dinotefuran @ 3 ppm (20SG @15 mg/kg seed) | 84.3 (66.66) | 0.33 (0.88) | 79.7 (63.17) | 1.33 (1.34) | 71.0 (57.40) | 27.3 (5.26) | 56.3 (48.62) | 30.00 (05.52) | 85.3 (67.46) | 0.12 (0.79) | 82.3 (65.12) | 0.43 (0.97) | 91.0 (72.57) | 0.0 (0.71) | 83.3 (65.88) | 0.0 (0.71) |
| $T_7$ | Emamectin benzoate @2ppm (5SG @40.0 mg/kg seed) | 79.7 (63.22) | 1.33 (1.34) | 75.3 (60.22) | 3.67 (2.04) | 72.3 (58.24) | 0.0 (0.71) | 60.7 (51.14) | 0.0 (0.71) | 81.0 (64.13) | 1.48 (1.41) | 80.0 (63.41) | 1.82 (1.52) | 92.3 (73.99) | 0.0 (0.71) | 79.0 (62.70) | 11.00 (3.38) |
| $T_8$ | Deltamethrin @ 1ppm (2.8EC @0.04 ml/kg of seed) | 78.7 (62.51) | 1.00 (1.17) | 74.7 (59.76) | 9.67 (3.18) | 75.7 (60.44) | 0.0 (0.71) | 63.0 (52.52) | 0.0 (0.71) | 81.0 (64.13) | 0.69 (1.09) | 78.3 (62.23) | 0.83 (1.15) | 94.0 (75.82) | 0.0 (0.71) | 90.0 (71.55) | 0.0 (0.71) |
| T9 | Untreated control | 54.0 (47.28) | 23.67 (4.91) | 27.7 (31.70) | 54.00 (7.37) | 76.0 (60.65) | 43.3 (6.62) | 64.3 (53.31) | 51.67 (7.22) | 67.7 (55.33) | 3.28 (1.94) | 64.7 (53.51) | 3.94 (2.11) | 87.0 (68.85) | 31.33 (5.64) | 73.7 (59.11) | 39.00 (6.28) |
| | $CD_{0.05}$ | 2.73 | 0.61 | 1.88 | 0.49 | 1.95 | 0.46 | 1.40 | 0.23 | 0.61 | 0.03 | 0.62 | 0.03 | 2.48 | 0.24 | 1.99 | 0.61 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.17: Effect of insecticidal seed treatment on per cent seed germination and per cent insect damage in Pigeon pea and green gram seeds**

| Symbol | Treatments | Pigeon pea | | | | Green gram | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PDKV, Akola | | | | UAS, Raichur | | | | OUAT, Bhubaneswar | | | | CSAUAT, Kanpur | | | | TNAU, Coimbatore | | | |
| | | 9 months | | 12 months | | 12 months | | 15 months | | 3 months | | 6 months | | 9 months | | 12 months | | 9 months | | 12 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | *G* | ID | G | ID | G | ID | G | ID |
| $T_1$ | Broflanilide @ 1 ppm (300 SC @3.33 mg /kg seed) | 84.3 (66.66) | 0.96 (1.21) | 81.7 (64.62) | 1.39 (1.37) | 92.3 (73.90) | 0.0 (0.71) | 88.7 (70.30) | 0.0 (0.71) | 90.0 | 0.33 (0.88) | 84.3 | 0.67 (1.05) | 82.3 (65.12) | 0.0 (0.71) | 69.0 (56.15) | 0.0 (0.71) | 88.7 (70.36) | 2.33 (1.68) | 85.3 (67.52) | 2.67 (1.78) |
| $T_2$ | Broflanilide @ 2 ppm (300 SC @6.66 mg /kg seed) | 84.0 (66.40) | 0.50 (1.00) | 80.7 (63.89) | 0.75 (1.12) | 93.3 (75.02) | 0.0 (0.71) | 90.7 (72.19) | 0.0 (0.71) | 90.3 | 0.00 (0.71) | 85.0 | 0.67 (1.05) | 87.3 (69.21) | 0.0 (0.71) | 51.7 (45.94) | 0.0 (0.71) | 89.3 (70.93) | 1.17 (1.29) | 86.0 (68.03) | 1.67 (1.47) |
| $T_3$ | Broflanilide @ 3 ppm (300 SC @9.99 mg /kg seed) | 84.7 (66.93) | 0.40 (0.95) | 82.0 (64.87) | 0.60 (1.05) | 94.0 (75.82) | 0.0 (0.71) | 91.7 (73.20) | 0.0 (0.71) | 89.7 | 0.00 (0.71) | 85.3 | 0.33 (0.88) | 90.0 (71.67) | 0.0 (0.71) | 48.7 (44.22) | 0.0 (0.71) | 90.7 (72.21) | 0.67 (1.07) | 87.3 (69.31) | 1.00 (1.21) |
| $T_4$ | Dinotefuran @ 1 ppm (20SG @5 mg/kg seed) | 83.7 (66.14) | 0.95 (1.20) | 80.0 (63.41) | 1.26 (1.33) | 93.0 (74.65) | 0.0 (0.71) | 89.7 (71.24) | 0.0 (0.71) | 89.3 | 0.67 (1.05) | 84.0 | 0.67 (1.05) | 88.3 (70.03) | 0.0 (0.71) | 49.7 (44.79) | 0.0 (0.71) | 87.3 (69.13) | 4.33 (2.20) | 85.3 (67.47) | 5.33 (2.41) |
| $T_5$ | Dinotefuran @ 2 ppm (20SG @10 mg/kg seed) | 83.0 (65.63) | 0.51 (1.00) | 80.7 (63.89) | 0.77 (1.12) | 92.7 (74.27) | 0.0 (0.71) | 89.3 (70.91) | 0.0 (0.71) | 90.0 | 0.00 (0.71) | 83.7 | 1.00 (1.22) | 89.3 (70.91) | 0.0 (0.71) | 49.3 (44.60) | 0.0 (0.71) | 88.0 (69.70) | 3.83 (2.08) | 86.7 (68.65) | 4.50 (2.23) |
| $T_6$ | Dinotefuran @ 3 ppm (20SG @15 mg/kg seed) | 84.3 (66.66) | 0.26 (0.87) | 82.3 (65.12) | 0.39 (0.94) | 93.7 (75.40) | 0.0 (0.71) | 91.3 (72.85) | 0.0 (0.71) | 89.3 | 0.00 (0.71) | 84.7 | 0.67 (1.00) | 83.7 (66.29) | 0.0 (0.71) | 50.3 (45.17) | 0.0 (0.71) | 87.3 (69.13) | 2.67 (1.78) | 86.7 (68.57) | 3.17 (1.91) |
| $T_7$ | Emamectin benzoate @2ppm (@40.0 mg/kg seed) | 82.0 (64.87) | 1.02 (1.23) | 79.3 (62.94) | 1.57 (1.44) | 91.7 (73.20) | 0.0 (0.71) | 88.3 (70.01) | 0.0 (0.71) | 90.0 | 0.00 (0.71) | 85.0 | 0.33 (0.88) | 89.0 (70.61) | 0.0 (0.71) | 42.7 (40.76) | 0.0 (0.71) | 86.7 (68.57) | 1.17 (1.29) | 85.3 (67.47) | 1.83 (1.53) |
| $T_8$ | Deltamethrin @ 1ppm (2.8EC @0.04 ml/kg of seed) | 81.7 (64.62) | 0.96 (1.21) | 78.3 (62.23) | 1.47 (1.40) | 90.7 (72.19) | 0.0 (0.71) | 88.0 (69.71) | 0.0 (0.71) | 89.7 | 0.67 (1.05) | 84.7 | 1.00 (1.17) | 85.7 (67.85) | 0.0 (0.71) | 45.0 (42.11) | 0.0 (0.71) | 85.3 (67.52) | 4.33 (2.19) | 81.3 (64.47) | 5.50 (2.45) |
| T9 | Untreated control | 78.7 (62.47) | 3.28 (1.94) | 72.3 (58.24) | 4.04 (2.13) | 88.7 (70.30) | 11.75 (3.50) | 81.7 (64.62) | 16.25 (4.09) | 87.0 | 22.33 (4.77) | 81.7 | 24.67 (5.02) | 77.7 (61.78) | 0.67 (1.05) | 37.3 (37.64) | 3.00 (1.81) | 82.7 (65.38) | 13.50 (3.74) | 77.3 (61.58) | 15.67 (4.02) |
| | $CD_{0.05}$ | 0.76 | 0.02 | 0.62 | 0.01 | 1.32 | 0.03 | 1.25 | 0.03 | NS | 0.36 | NS | 0.55 | 3.83 | 0.17 | 3.26 | 0.32 | 2.31 | 0.21 | 3.90 | *0.22* |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.18: Effect of insecticidal seed treatment on per cent seed germination and per cent insect damage in field pea, cowpea and horse gram seeds**

| Symbol | Treatments | Field pea | | | | Cowpea | | | | | | | | Horse gram | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CSAUAT, Kanpur | | | | UAS, Dharwad | | | | UAS, Bangalore | | | | IISS, RS, Bangalore | | | |
| | | 9 months | | 12 months | | 9 months | | 12 months | | 3 months | | 6 months | | 9 months | | 12 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | Broflanilide @ 1 ppm (300 SC @3.33 mg /kg seed) | 89.0 (70.61) | 0.0 (0.71) | 78.0 (62.02) | 0.33 (00.88) | 77.1 (61.42) | 0.0 (0.71) | 67.1 (54.98) | 7.33 (2.77) | 68.0 (55.56) | 7.49 (2.82) | 51.3 (45.75) | 10.47 (3.31) | 81.3 (64.38) | 0.15 (0.81) | 78.0 (62.03) | 0.42 (0.96) |
| $T_2$ | Broflanilide @ 2 ppm (300 SC @6.66 mg /kg seed) | 90.0 (71.55) | 0.0 (0.71) | 52.3 (46.32) | 0.0 (0.71) | 83.8 (66.32) | 0.0 (0.71) | 72.9 (58.65) | 4.67 (2.26) | 76.0 (60.65) | 3.97 (2.11) | 67.0 (54.93) | 6.66 (2.67) | 81.7 (64.63) | 0.05 (0.74) | 80.7 (63.90) | 0.35 (0.92) |
| $T_3$ | Broflanilide @ 3 ppm (300 SC @9.99 mg /kg seed) | 88.0 (69.71) | 0.0 (0.71) | 44.0 (41.54) | 0.0 (0.71) | 85.9 (67.95) | 0.0 (0.71) | 76.4 (60.96) | 1.33 (1.34) | 93.0 (74.73) | 1.33 (1.34) | 77.7 (61.80) | 1.64 (1.45) | 83.0 (65.63) | 0.03 (0.73) | 82.0 (64.87) | 0.30 (0.89) |
| $T_4$ | Dinotefuran @ 1 ppm (20SG @5 mg/kg seed) | 89.7 (71.23) | 0.0 (0.71) | 39.7 (39.02) | 0.0 (0.71) | 81.0 (64.34) | 0.0 (0.71) | 70.4 (57.11) | 1.67 (1.46) | 72.7 (58.46) | 8.07 (2.93) | 70.3 (57.04) | 10.82 (3.36) | 78.7 (62.47) | 0.15 (0.81) | 77.7 (61.80) | 0.52 (1.01) |
| $T_5$ | Dinotefuran @ 2 ppm (20SG @10 mg/kg seed) | 88.7 (70.30) | 0.0 (0.71) | 47.3 (43.45) | 0.0 (0.71) | 83.8 (66.31) | 0.0 (0.71) | 72.9 (58.64) | 0.67 (1.05) | 75.3 (60.21) | 3.88 (2.09) | 59.3 (50.46) | 7.21 (2.78) | 81.3 (64.38) | 0.12 (0.79) | 80.0 (63.41) | 0.50 (1.00) |
| $T_6$ | Dinotefuran @ 3 ppm (20SG @15 mg/kg seed) | 90.0 (71.55) | 0.0 (0.71) | 53.3 (46.89) | 0.0 (0.71) | 84.6 (66.90) | 0.0 (0.71) | 73.6 (59.08) | 0.67 (1.00) | 91.0 (72.53) | 1.09 (1.26) | 82.7 (65.41) | 1.45 (1.39) | 82.0 (64.87) | 0.08 (0.76) | 81.3 (64.38) | 0.46 (0.98) |
| $T_7$ | Emamectin benzoate @2ppm (@40.0 mg/kg seed) | 87.0 (68.87) | 0.0 (0.71) | 40.0 (39.21) | 0.67 (01.05) | 83.2 (65.79) | 0.0 (0.71) | 72.4 (58.28) | 1.00 (1.17) | 85.0 (67.25) | 1.24 (1.32) | 79.3 (62.94) | 1.48 (1.41) | 78.7 (62.47) | 0.33 (0.91) | 77.3 (61.55) | 0.58 (1.04) |
| $T_8$ | Deltamethrin @ 1ppm (2.8EC @0.04 ml/kg of seed) | 88.3 (70.03) | 0.0 (0.71) | 49.3 (44.60) | 0.0 (0.71) | 85.8 (67.81) | 0.0 (0.71) | 74.6 (59.72) | 0.67 (1.05) | 89.3 (70.93) | 0.96 (1.21) | 78.3 (62.25) | 1.77 (1.50) | 81.3 (64.38) | 0.16 (0.81) | 80.7 (63.90) | 0.44 (0.97) |
| T9 | Untreated control | 83.3 (65.91) | 4.00 (2.11) | 35.7 (36.65) | 8.33 (2.95) | 72.3 (58.26) | 55.0 (7.43) | 61.8 (51.79) | 72.33 (8.52) | 67.0 (54.95) | 14.26 (3.84) | 50.3 (45.17) | 35.35 (5.98) | 55.0 (47.86) | 10.12 (3.25) | 48.3 (44.02) | 21.48 (4.65) |
| | $CD_{0.05}$ | 1.87 | 0.14 | 2.06 | 0.34 | 3.71 | 0.36 | 2.89 | 0.65 | 3.26 | 0.26 | 5.97 | 0.26 | 2.11 | 0.14 | 3.04 | 0.40 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.19: Effect of insecticidal seed treatment on per cent seed germination and per cent insect damage in black gram and groundnut seeds**

| Symbol | Treatments | Black gram | | | | | | | | | | | | Groundnut | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TNAU, Coimbatore | | | | PAJANCOA, Karaikal | | | | UAS, Bangalore | | | | JAU, Junagadh | | | |
| | | 9 months | | 12 months | | 3 months | | 6 months | | 3 months | | 6 months | | 9 months | | 12 months | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | Broflanilide @ 1 ppm (300 SC @3.33 mg /kg seed) | 90.7 (72.21) | 0.83 (1.15) | 87.3 (69.13) | 1.50 (1.41) | 84.5 (66.82) | 0.22 (0.85) | 80.0 (63.48) | 0.67 (1.08) | 71.7 (57.82) | 7.43 (2.81) | 62.0 (51.93) | 10.20 (3.27) | 72.0 (58.04) | 0.00 (0.71) | 53.3 (46.90) | 0.00 (0.71) |
| $T_2$ | Broflanilide @ 2 ppm (300 SC @6.66 mg /kg seed) | 90.0 (71.54) | 0.50 (1.00) | 86.7 (68.57) | 1.00 (1.21) | 88.5 (70.20) | 0.07 (0.75) | 84.0 (66.42) | 0.44 (0.97) | 77.3 (61.55) | 3.56 (2.01) | 70.7 (57.19) | 7.34 (2.80) | 73.3 (58.98) | 0.00 (0.71) | 60.0 (50.75) | 0.00 (0.71) |
| $T_3$ | Broflanilide @ 3 ppm (300 SC @9.99 mg /kg seed) | 89.3 (70.93) | 0.00 (0.71) | 86.7 (68.57) | 0.33 (0.90) | 90.0 (71.68) | 0.00 (0.71) | 85.5 (67.63) | 0.23 (0.86) | 92.7 (74.31) | 0.94 (1.20) | 84.3 (66.75) | 1.35 (1.36) | 73.3 (58.91) | 0.00 (0.71) | 61.7 (51.74) | 0.00 (0.71) |
| $T_4$ | Dinotefuran @ 1 ppm (20SG @5 mg/kg seed) | 88.7 (70.31) | 3.67 (2.04) | 85.3 (67.50) | 6.50 (2.64) | 86.0 (68.03) | 0.15 (0.81) | 84.0 (66.45) | 0.37 (0.93) | 69.7 (56.56) | 6.36 (2.61) | 68.7 (55.95) | 9.45 (3.15) | 70.0 (56.77) | 5.67 (2.48) | 50.0 (44.98) | 7.00 (2.73) |
| $T_5$ | Dinotefuran @ 2 ppm (20SG @10 mg/kg seed) | 88.0 (69.75) | 3.50 (2.00) | 85.3 (67.47) | 6.33 (2.61) | 90.0 (71.58) | 0.00 (0.71) | 86.0 (68.03) | 0.23 (0.85) | 76.0 (60.69) | 4.04 (2.13) | 72.0 (58.04) | 7.07 (2.75) | 70.0 (56.77) | 4.67 (2.26) | 51.7 (45.94) | 6.33 (2.61) |
| $T_6$ | Dinotefuran @ 3 ppm (20SG @15 mg/kg seed) | 87.3 (69.13) | 3.33 (1.96) | 84.7 (66.93) | 5.83 (2.52) | 92.5 (74.17) | 0.00 (0.71) | 88.0 (69.74) | 0.07 (0.75) | 90.7 (72.52) | 1.34 (1.35) | 88.7 (70.37) | 1.40 (1.38) | 71.3 (57.61) | 4.33 (2.20) | 51.7 (45.94) | 5.33 (2.41) |
| $T_7$ | Emamectin benzoate @2ppm (@40.0 mg/kg seed) | 88.7 (70.31) | 3.17 (1.91) | 87.3 (69.13) | 5.67 (2.48) | 91.5 (73.14) | 0.00 (0.71) | 86.0 (68.07) | 0.37 (0.93) | 86.0 (68.03) | 1.48 (1.40) | 83.3 (65.96) | 2.34 (1.67) | 75.0 (60.05) | 0.00 (0.71) | 66.7 (54.81) | 0.00 (0.71) |
| $T_8$ | Deltamethrin @ 1ppm (2.8EC @0.04 ml/kg of seed) | 87.3 (69.18) | 4.17 (2.16) | 84.7 (66.93) | 7.83 (2.89) | 89.5 (71.12) | 0.00 (0.71) | 85.0 (67.24) | 0.30 (0.90) | 88.3 (70.07) | 1.43 (1.38) | 81.0 (64.14) | 1.45 (1.40) | 78.3 (62.27) | 0.00 (0.71) | 70.0 (56.77) | 0.00 (0.71) |
| T9 | Untreated control | 86.0 (68.03) | 7.33 (2.80) | 81.3 (64.38) | 13.67 (3.76) | 79.5 (63.07) | 0.81 (1.15) | 76.5 (60.99) | 2.00 (1.58) | 66.0 (54.32) | 11.13 (3.41) | 49.0 (44.41) | 22.45 (4.79) | 68.3 (55.75) | 9.33 (3.13) | 46.7 (43.07) | 12.67 (3.63) |
| | $CD_{0.05}$ | 2.27 | 0.11 | 1.88 | 0.22 | 2.80 | 0.01 | 2.68 | 0.02 | 3.70 | 0.28 | 3.17 | 0.25 | 3.54 | 0.20 | 3.81 | 0.20 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

**Table 4.20: Effect of insecticidal seed treatment on per cent seed germination and per cent insect damage in chickpea and vegetable pea seeds**

| *Symbol* | *Treatments* | Chickpea | | | | Vegetable pea | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MPKV, Rahuri | | | | IIVR, Varanasi | | | |
| | | 9 months | | 12 months | | 6 months | | 9 months | |
| | | G | ID | G | ID | G | ID | G | ID |
| $T_1$ | Broflanilide @ 1 ppm (300 SC @3.33 mg /kg seed) | 90.0 (71.55) | 1.33 (01.34) | 89.0 (70.61) | 5.00 (02.34) | 88.3 | 0.58 (1.04) | 86.7 | 1.25 (1.32) |
| $T_2$ | Broflanilide @ 2 ppm (300 SC @6.66 mg /kg seed) | 91.7 (73.28) | 0.0 (0.71) | 90.3 (71.96) | 3.67 (02.04) | 88.3 | 0.33 (0.91) | 86.7 | 0.67 (1.08) |
| $T_3$ | Broflanilide @ 3 ppm (300 SC @9.99 mg /kg seed) | 94.7 (76.63) | 0.0 (0.71) | 92.7 (74.31) | 0.0 (0.71) | 86.7 | 0.08 (0.76) | 85.0 | 0.33 (0.91) |
| $T_4$ | Dinotefuran @ 1 ppm (20SG @5 mg/kg seed) | 89.7 (71.23) | 1.00 (01.22) | 87.7 (69.41) | 5.67 (02.47) | 86.7 | 0.42 (0.96) | 86.7 | 0.83 (1.15) |
| $T_5$ | Dinotefuran @ 2 ppm (20SG @10 mg/kg seed) | 90.7 (72.26) | 0.0 (0.71) | 89.3 (70.94) | 4.33 (02.20) | 90.0 | 0.17 (0.81) | 88.3 | 0.42 (0.96) |
| $T_6$ | Dinotefuran @ 3 ppm (20SG @15 mg/kg seed) | 92.0 (73.56) | 0.0 (0.71) | 90.7 (72.21) | 0.0 (0.71) | 90.0 | 0.08 (0.76) | 86.7 | 0.17 (0.81) |
| $T_7$ | Emamectin benzoate @2ppm (@40.0 mg/kg seed) | 89.7 (71.23) | 0.0 (0.71) | 87.3 (69.13) | 1.00 (01.22) | 90.0 | 0.08 (0.76) | 86.7 | 0.17 (0.81) |
| $T_8$ | Deltamethrin @ 1ppm (2.8EC @0.04 ml/kg of seed) | 93.0 (74.65) | 0.0 (0.71) | 91.3 (72.89) | 0.0 (0.71) | 90.0 | 0.17 (0.81) | 88.3 | 0.67 (1.07) |
| *T9* | Untreated control | 83.7 (66.14) | 18.0 (4.30) | 80.7 (63.89) | 24.0 (4.95) | 88.3 | 2.17 (1.63) | 86.7 | 3.08 (1.89) |
| | $CD_{0.05}$ | 2.14 | 0.14 | 2.31 | 0.25 | NS | 0.15 | NS | 0.17 |

*G- Per cent seed germination, ID- per cent insect damage N.B. figures in parentheses are transformed values

❖ **Evaluation of newer insecticides as alternative of deltamethrin for seed storage godown disinfection**

Among the various approaches used to manage storage pests, disinfection of storage structures remains an effective and widely practiced method. Deltamethrin, a synthetic pyrethroid, has long been utilized for this purpose due to its broad-spectrum insecticidal action, residual efficacy. In view of its very high toxicity towards non-target organisms, newer insecticides (spinetoram, broflanilide) having very low toxicity have been tried to evaluate their efficacy as alternative of deltamethrin. Preliminary study revealed significant variations in adult mortality across locations, storage durations (0, 3, and 6 MAT), and exposure intervals (24, 48, and 72 HAT i.e. hour after treatment). Across all treatments, mortality increased markedly with exposure time. Irrespective of the test insects under study *viz., R. dominica, S. oryzae, C. maculatus/C. chinensis*, and *T. castaneum,* T6 (broflanilide 300 SC @ 200 ppm a.i.) consistently resulted in significantly higher adult mortality within 72 HAT (hour after treatment) across the locations even after 3 and 6 months of treatment imposition. In most of cases, T6 (broflanilide 300 SC@200 ppm) recorded 100% mortality at 48 HAT even after 3 months of treatment imposition indicating strong persistence and sustained insecticidal action. Treatment T4 (Spinetoram 11.7% SC @200 ppm a.i) was also found to be next best insecticide among all other treatments.

**Table 4.21: Percent mortality of *S. oryzae* released on newer insecticide treated godown floor at different time interval**

| | PAJANCOA&RI, Karaikal | | | | | | OUAT, Bhubaneswar | | | | | | | | | TNAU, Coimbatore | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 MAT | | 3 MAT | | 6 MAT | | 0 MAT | | | 3 MAT | | | 6 MAT | | | 0 MAT | | 3 MAT | | |
| **Treatments** | **24 HAT** | **48 HAT** | **24 HAT** | **48 HAT** | **24 HAT** | **48 HAT** | **24 HAT** | **48 HAT** | **72 HAT** | **24 HAT** | **48 HAT** | **72 HAT** | **24 HAT** | **48 HAT** | **72 HAT** | **24 HAT** | **48 HAT** | **24 HAT** | **48 HAT** | **72 HAT** |
| T1 | 76.66 (61.12) | 100 | 75.57 (60.4) | 100 | 72.23 (58.23) | 100 | 55.57 (48.17) | 65.567 (54.05) | 91.100 (72.68) | 44.43 (41.78) | 64.43 (53.37) | 71.10 (57.46) | 33.30 (35.23) | 44.43 (41.78) | 61.100 (51.39) | 99.00 (86.48) | 100 | 93.33 (81.13) | 100 | 100 |
| T2 | 82.2 (65.41) | 100 | 87.77 (69.80) | 100 | 80.0 (63.45) | 100 | 65.57 (54.05) | 83.30 (65.85) | 98.90 (86.50) | 54.43 (47.52) | 73.33 (58.91) | 81.10 (64.22) | 44.43 (41.78) | 54.43 (47.52) | 71.10 (57.48) | 100 (90.0) | 100 | 100 (90.0) | 100 | 100 |
| T3 | 90.00 (72.29) | 100 | 88.90 (70.55) | 100 | 81.13 (64.36) | 100 | 65.57 (54.05) | 75.57 (60.36) | 92.233 (74.19) | 54.43 (47.52) | 68.87 (56.10) | 76.67 (61.12) | 38.90 (38.55) | 54.43 (47.52) | 62.23 (52.07) | 100 (90.0) | 100 | 96.67 (83.84) | 100 | 100 |
| T4 | 94.46 (76.84) | 100 | 93.33 (75.33) | 100 | 90.00 (71.69) | 100 | 74.43 (59.61) | 85.57 (67.67) | 98.90 (86.50) | 64.43 (53.37) | 78.90 (62.64) | 86.70 (68.58) | 54.43 (47.52) | 64.43 (53.37) | 73.33 (58.91) | 100 (90.0) | 100 | 98.89 (86.48) | 100 | 100 |
| T5 | 83.33 (66.11) | 100 | 83.33 (65.94) | 100 | 83.33 (65.94) | 100 | 73.30 (58.86) | 84.43 (66.76) | 95.57 (77.99) | 64.43 (53.37) | 76.67 (61.12) | 84.43 (66.76) | 55.53 (48.16) | 63.33 (52.72) | 68.90 (56.11) | 100 (90.0) | 100 | 95.56 (80.33) | 100 | 100 |
| T6 | 93.30 (74.96) | 100 | 92.20 (73.82) | 100 | 87.80 (69.56) | 100 | 83.30 (65.85) | 94.43 (76.47) | 100 (90.00) | 74.43 (59.61) | 85.57 (67.67) | 91.10 (72.68) | 65.533 (54.05) | 74.43 (59.61) | 82.23 (65.13) | 100 (90.0) | 100 | 96.67 (83.84) | 100 | 100 |
| T7 | 100.0 (90.00) | 100 | 100.0 (90.00) | 100 | 96.70 (79.50) | 100 | 66.70 (54.73) | 84.43 (66.76) | 100.0 (90.00) | 56.70 (48.83) | 75.57 (60.43) | 80.00 (63.45) | 48.90 (44.35) | 56.67 (48.81) | 65.53 (54.05) | 97 (83.84) | 100 | 80.00 (63.46) | 85.57 | 91.11 |
| T8 | 0.00 (0.29) | 0.0 | 0.0 (0.29) | 0.0 | 0.0 (0.29) | 0.0 | 0.0 (0.29) | 0.0 (0.29) | 2.20 (6.97) | 3.30 (10.46) | 0.0 (0.29) | 3.30 (10.46) | 0.0 (0.29) | 0.0 (0.29) | 3.30 (10.46) | 0.0 (0.29) | 0.0 | 0.0 (0.29) | 0.0 | 0.0 |
| CD value | 8.16 | - | 4.72 | 0.0 | 5.60 | - | 1.48 | 2.57 | 7.35 | 1.78 | 3.74 | 2.81 | 2.95 | 2.36 | 3.76 | 7.58 | - | 15.01 | 2.54 | 8.23 |

*T1: Emamectin benzoate 5 SG @100 ppm a.i; T2: Emamectin benzoate 5 SG @200 ppm a.i ; T3: Spinetoram 11.7% SC @100 ppm a.i; T4: Spinetoram 11.7% SC @200 ppm a.i; T5: Broflanilide 300 SC @100 ppm a.i; T6: Broflanilide 300 SC@200 ppm a.i; T7: Deltamethrin 2.5%WP; T8: Control*

**Table 4.22: Percent mortality of *Callosobruchus* sp. released on newer insecticide treated godown floor at different time interval**

| Treatments | MPKV, Rahuri | | | | | | | | | TNAU, Coimbatore | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 MAT | | | 3 MAT | | | 6 MAT | | | 0 MAT | | 3 MAT | | |
| | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 24 HAT | 48 HAT | 72 HAT |
| T1 | 27.78 (31.78) | 44.44 (41.77) | 57.78 (49.47) | 17.78 (24.91) | 20.00 (26.41) | 41.11 (39.84) | 8.89 (17.27) | 8.89 (20.41) | 28.89 (32.33) | 96.7 (83.84) | 100 | 63.33 (52.76) | 92.22 (74.17) | 100 |
| T2 | 41.11 (39.86) | 53.33 (46.90) | 65.56 (54.07) | 24.44 (29.60) | 31.11 (33.85) | 50.00 (44.98) | 10.00 (18.00) | 10.00 (28.01) | 32.22 (34.52) | 100 (90.00) | 100 | 82.22 (65.43) | 97.78 (85.00) | 100 |
| T3 | 32.22 (34.54) | 47.78 (43.70) | 66.67 (54.85) | 22.22 (28.06) | 32.22 (34.56) | 51.11 (45.61) | 10.00 (17.67) | 10.00 (28.83) | 34.44 (35.90) | 71.11 (57.47) | 100 | 66.66 (54.73) | 91.11 (72.69) | 100 |
| T4 | 51.11 (45.61) | 62.22 (52.05) | 76.67 (61.09) | 37.78 (37.90) | 47.78 (43.70) | 60.00 (50.75) | 23.33 (28.83) | 23.33 (37.25) | 44.44 (41.79) | 94.44 (78.84) | 100 | 87.77 (69.98) | 97.78 (85.00) | 100 |
| T5 | 53.33 (46.89) | 74.44 (60.05) | 88.89 (71.46) | 42.22 (40.48) | 52.22 (46.26) | 64.44 (53.43) | 22.22 (27.94) | 22.22 (37.85) | 50.00 (44.98) | 96.67 (83.84) | 100 | 74.44 (59.68) | 95.55 (80.00) | 100 |
| T6 | 72.22 (58.23) | 82.22 (65.12) | 93.33 (75.33) | 57.78 (49.46) | 68.89 (56.08) | 70.00 (57.09) | 42.22 (40.50) | 42.22 (49.45) | 60.00 (50.74) | 100 (90.00) | 100 | 94.44 (78.84) | 98.89 (86.48) | 100 |
| T7 | 77.78 (61.90) | 90.00 (71.53) | 97.78 (82.96) | 60.00 (50.78) | 73.33 (58.96) | 80.00 (63.40) | 50.00 (44.98) | 50.00 (50.75) | 68.89 (56.12) | 87.7 (69.81) | 100 | 67.77 (55.62) | 71.11 (57.47) | 100 |
| T8 | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.0 | 0.00 (0.29) | 0.00 (0.29) | 0.0 |
| CD value | 5.30 | 6.54 | 6.03 | 4.79 | 4.83 | 6.30 | 4.43 | 4.23 | 5.07 | 11.49 | - | 9.75 | 10.48 | - |

*T1: Emamectin benzoate 5 SG @100 ppm a.i; T2: Emamectin benzoate 5 SG @200 ppm a.i ; T3: Spinetoram 11.7% SC @100 ppm a.i; T4: Spinetoram 11.7% SC @200 ppm a.i; T5: Broflanilide 300 SC @100 ppm a.i; T6: Broflanilide 300 SC@200 ppm a.i; T7: Deltamethrin 2.5%WP; T8: Control*

**Table 4.23: Percent mortality of *T. castaneum* released on newer insecticide treated godown floor at different time interval**

| | OUAT, Bhubaneswar | | | | | | | | | TNAU, Coimbatore | | | | | | PJTSAU, Telangana | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | 0 MAT | | | 3 MAT | | | 6 MAT | | | 0 MAT | | | 3 MAT | | | 0 MAT | | | 3MAT | | | 6 MAT | | |
| | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT |
| T1 | 64.43 (53.37) | 74.43 (59.61) | 83.3 (66.76) | 52.23 (46.26) | 74.43 (59.61) | 74.43 (59.61) | 27.8 (31.79) | 34.43 (35.91) | 43.3 (41.78) | 83.33 (65.94) | 91.1 (72.69) | 100 | 74.44 (59.68) | 80.00 (63.46) | 100 (90.00) | 24.43 (29.53 ) | 23.33 (28.83) | 43.33 (45.63) | 2.21 (6.99) | 16.67 (24.78) | 30.00 (33.05) | 0.0 | 37.77 (37.87) | 47.77 (43.69) |
| T2 | 74.43 (59.61) | 84.43 (66.76) | 90 (71.53) | 66.67 (54.73) | 84.43 (66.76) | 84.43 (66.76) | 40 (39.21) | 45.56 (42.43) | 53.3 (47.52) | 91.11 (72.69) | 94.4 (76.81) | 100 | 81.11 (64.61) | 85.56 (68.75) | 100 (90.0) | 36.70 (37.27 ) | 52.20 (46.25) | 53.33 (57.71) | 6.68 (14.97) | 40.00 (35.85) | 84.43 (66.93) | 0.0 | 49.99 (44.97) | 62.21 (52.05) |
| T3 | 75.56 (60.36) | 85.56 (67.67) | 93.3 (74.96) | 67.77 (55.43) | 85.57 (67.67) | 90 (71.53) | 41.1 (39.85) | 54.43 (47.52) | 63.3 (53.37) | 83.33 (65.94) | 96.7 (83.84) | 100 | 70.00 (56.78) | 81.11 (65.05) | 100 (90.0) | 25.53 (29.62 ) | 32.23 (34.34) | 20.00 (34.98) | 3.33 (10.51) | 13.33 (20.40) | 26.68 (31.08) | 0.0 | 35.54 (36.57) | 46.66 (43.06) |
| T4 | 85.56 (67.67) | 93.3 (74.96) | 96.7 (77.99) | 83.33 (65.94) | 93.3 (74.96) | 94.43 (76.47) | 55.7 (48.18) | 64.43 (53.37) | 73.3 (59.61) | 100.0 (90.00) | 100 (90.0) | 100 | 96.67 (83.84) | 100 (90.0) | 100 (90.0) | 25.57 (30.28 ) | 50.00 (44.98) | 50.00 (48.82) | 4.43 (11.97) | 30.00 (28.71) | 51.10 (45.61) | 0.0 | 50.01 (44.99) | 65.56 (54.11) |
| T5 | 86.7 (68.58) | 95.56 (77.99) | 100 (90.0) | 77.77 (61.94) | 95.57 (77.99) | 95.56 (77.99) | 62.2 (52.04) | 74.43 (59.61) | 83.3 (66.76) | 95.56 (80.33) | 100 (90.0) | 100 | 88.89 (71.46) | 100 (90.0) | 100 (90.0) | 22.23 (28.02 ) | 31.10 (33.66) | 70.00 (58.29) | 7.79 (16.12) | 50.00 (37.11) | 86.65 (68.91) | 0.0 | 52.21 (46.24) | 75.56 (60.42) |
| T6 | 95.56 (77.99) | 100 (90.0) | 100 (90.0) | 90.00 (71.69) | 100 (90.0) | 100 (90.00) | 75.5 (60.36) | 84.43 (66.76) | 93.3 (76.47) | 100.0 (90.00) | 100 (90.0) | 100 | 94.44 (81.95) | 100.0 (90.0) | 100 (90.0) | 42.00 (40.36 ) | 53.33 (46.90) | 83.33 (72.30) | 18.88 (25.60) | 80.00 (53.69) | 97.79 (82.98) | 0.0 | 67.79 (55.40) | 95.54 (77.95) |
| T7 | 75.56 (60.36) | 85.56 (67.67) | 90 (70.55) | 69.97 (56.80) | 85.57 (67.67) | 85.56 (67.67) | 46.63 (43.04) | 55.56 (48.17) | 63.3 (53.37) | 82.22 (65.12) | 96.7 (81.48) | 100 | 63.33 (52.81) | 76.67 (61.69) | 91.11 (76.13) | 25.57 (30.35 ) | 27.80 (31.79) | 40.00 (35.85) | 3.32 (10.49) | 23.33 (27.28) | 27.77 (31.72) | 0.0 | 38.90 (38.56) | 54.44 (47.53) |
| T8 | 2.2 (6.97) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 3.33 (8.48) | 4.43 (9.95) | 0.00 (0.29) | 2.2 (6.97) | 3.3 (6.97) | 0.00 (0.29) | 0.00 (0.29) | 0.0 | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.00 (0.29) | 0.0 | 0.00 (0.29) | 0.00 (0.29) |
| CD | 4.46 | 2.47 | 2.16 | 4.93 | 5.35 | 4.65 | 3.35 | 4.24 | 4.49 | 6.53 | 8.68 | - | 13.20 | 9.75 | 8.23 | 7.28 | 7.96 | 8.99 | 4.86 | 8.73 | 6.96 | - | 3.31 | 4.55 |

*T1: Emamectin benzoate 5 SG @100 ppm a.i; T2: Emamectin benzoate 5 SG @200 ppm a.i ; T3: Spinetoram 11.7% SC @100 ppm a.i; T4: Spinetoram 11.7% SC @200 ppm a.i; T5: Broflanilide 300 SC @100 ppm a.i; T6: Broflanilide 300 SC@200 ppm a.i; T7: Deltamethrin 2.5%WP; T8: Control*

**Table 4.24: Percent mortality of *R. dominica* released on newer insecticide treated godown floor at different time interval**

| Treatments | TNAU, Coimbatore | | | | | OUAT, Bhubaneswar | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 MAT | | 3 MAT | | | 0 MAT | | | 3 MAT | | | 6 MAT | | |
| | 24 HAT | 48 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT | 24 HAT | 48 HAT | 72 HAT |
| T1 | 97.77 (85.00) | 100 | 70.00 (56.78) | 83.33 (65.94) | 98.89 (86.48) | 74.44 (59.61) | 84.44 (66.76) | 94.44 (76.47) | 63.33 (52.72) | 74.44 (59.61) | 84.44 (66.76) | 44.44 (41.78) | 54.44 (47.52) | 63.30 (52.72) |
| T2 | 100 (90.00) | 100 | 83.34 (66.07) | 97.78 (82.96) | 100 (90.0) | 84.44 (66.76) | 94.44 (76.47) | 100 (90.0) | 73.33 (58.91) | 84.44 (66.76) | 94.44 (76.47) | 54.44 (47.52) | 64.44 (53.37) | 74.44 (59.61) |
| T3 | 100 (90.00) | 100 | 88.89 (70.54) | 97.78 (82.96) | 100 (90.0) | 80.00 (63.45) | 94.44 (76.47) | 100 (90.0) | 62.22 (52.07) | 83.33 (65.94) | 94.44 (76.47) | 54.44 (47.52) | 64.44 (53.37) | 74.44 (59.61) |
| T4 | 100 (90.00) | 100 | 96.67 (81.48) | 100 (90.00) | 100 (90.0) | 94.44 (76.47) | 100 (90.0) | 100 (90.0) | 83.33 (65.94) | 94.44 (76.47) | 100 (90.0) | 64.44 (53.37) | 74.44 (59.61) | 84.44 (66.76) |
| T5 | 100 (90.00) | 100 | 82.22 (65.12) | 95.56 (77.97) | 100 (90.0) | 94.44 (76.47) | 98.89 (90.0) | 100 (90.0) | 72.22 (58.21) | 94.44 (76.47) | 100 (90.0) | 74.44 (59.61) | 84.44 (66.76) | 94.44 (76.47) |
| T6 | 100 (90.00) | 100 | 91.11 (72.69) | 100 (90.0) | 100 (90.0) | 96.67 (79.50) | 100 (90.0) | 100 (90.0) | 93.33 (75.33) | 100 (90.00) | 100 (90.0) | 84.44 (66.76) | 94.44 (76.47) | 100 (90.0) |
| T7 | 100 (90.00) | 100 | 75.56 (60.35) | 84.44 (66.94) | 100 (90.0) | 85.56 (67.67) | 91.11 (72.68) | 93.33 (74.96) | 75.56 (60.37) | 84.44 (66.76) | 90.0 (71.53) | 54.44 (47.52) | 64.44 (53.37) | 84.44 (66.76) |
| T8 | 0.0 (0.29) | 0 | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) | 0.0 (0.29) |
| CD | 5.34 | - | 7.27 | 6.32 | 3.76 | 4.61 | 2.77 | 4.07 | 4.94 | 3.21 | 4.48 | 4.61 | 4.61 | 2.41 |

*T1: Emamectin benzoate 5 SG @100 ppm a.i; T2: Emamectin benzoate 5 SG @200 ppm a.i ; T3: Spinetoram 11.7% SC @100 ppm a.i; T4: Spinetoram 11.7% SC @200 ppm a.i; T5: Broflanilide 300 SC @100 ppm a.i; T6: Broflanilide 300 SC@200 ppm a.i; T7: Deltamethrin 2.5%WP; T8: Control*

## E. Seed Processing

❖ **Experiment 1: Optimum sieve size and type of screen for grading seeds of different crop varieties and hybrids including their parents**

**Crop: Paddy**

For thickness grading in paddy varieties Pusa Narendra Kala Namak 101 (fine seeded) and RNR 15048 (short slender), grading sieve size of 1.50 mm (s) was optimized against recommended size of 1.70 mm (s). For the variety PDKV Sakoli (Red Rice 1) (short slender), grading sieve size of 1.40 mm (s) was optimized against recommended size of 1.70 mm (s). For the paddy varieties PB 1985 (medium slender), PB 1979 (medium slender), PB 1692 (medium slender) and PB 1885 (medium slender), grading sieve size of 1.80 mm (s) was maintained as recommended, whereas PB 1847 (medium slender) was standardized at 1.90 mm (s) against recommended size of 1.80 mm (s). Grading sieve size of 1.80 mm (s) was optimized for KKL(R) 3 (long bold), PDKV Sadhana (long slender) and Sakoli 8 (long slender) against recommended size of 1.85 mm (s). For the variety MTU 7029 (bold seeded), grading sieve size of 1.65 mm (s) was optimized against recommended size of 1.85 mm (s). Grading sieve size of 2.10 mm (s) was recommended for PR 132 (long slender) against recommended sieve size of 1.85 mm (s). Grading sieve size of 1.60 mm (s) was standardized for PDKV Ganesh (short slender) and CO 59 (medium slender) against recommended sieve size of 1.70/1.80 mm (s). Grading sieve size of 1.55 mm (s) was recommended for ADT(R) 54 (fine seeded), ADT(R) 58 (fine seeded), BPT 5204 (medium slender) and KNM 1638 (medium slender) against recommended sieve size of 1.70/1.80 mm (s).

**Crop: Wheat**

Optimum sieve size for thickness grading in bold seeded wheat varieties HD 3385, HD 3386, HD 3406 and HD 3249 was found to be 2.40 mm (s), whereas for the varieties DBW 187 and HD 2967, grading sieve size of 1.80 mm (s) and 2.00 mm (s) were found suitable in NEPZ against the recommended sieve 2.30 mm (s). In case of wheat variety PBD 872, grading sieve size of 2.30 mm (s) was maintained as recommended. For the bold-seeded genotypes from NEPZ *viz.,* AAIW 6, AAIW 15, AAIW 52, 2.50 mm sieve and for medium seeded genotypes (AAIW 9, AAIW 10, AAIW 13), 2.25 mm sieve size was found to be optimum for maximum recovery of pure live seed meeting the IMSC standards.

**Crop: Mustard**

Grading sieve size of 1.7mm (r) was optimized for mustard varieties PM 34 and PM 32 for better grading against the recommended sieve sizes of 0.9/1.00mm (s)/1.4mm (r).

**Crop: Chickpea**

Optimum grading sieve size for medium seeded chickpea varieties viz., PDKV Harita, Super Jaki and PDKV Kanak (AKG 1303) was found to be 6.0 mm (r) against recommended size 5.50

mm (r); whereas for medium seeded variety BGD 204, the grading sieve size maintained 5.50 mm (r) as recommended. Optimum grading sieve size of 7.0 mm (r) and 8.0 mm (r) was standardized for the bold seeded Kabuli chickpea varieties viz., PDKV Kabuli-2 and PDKV Kabuli-4, respectively, against recommended sieve size of 6.0 mm (r).

**Crop: Soybean**

Optimum grading sieve size was found to be 3.75mm (s) and 3.80mm (s) for soybean variety DSb 34 evaluated at UAS, Dharwad and UAS, Raichur, respectively, against the recommended sieve size of 4.00mm (s). Soybean (veg.) *cv*. Krishnaprabha Pinakini from UAS Bagalkote could be processed by using grading sieve size of 4.60 mm (s) to meet the IMSC standards against the recommended sieve size of 4.00 mm (s).

**Crop: Chilli**

Optimum grading sieve size for chilli variety Krishna Prabha Rudra was found to be 2.50 mm (r) against the recommended size of 2.10 mm (r).

**Crop: Maize**

Optimum grading sieve size was found to be 6.50 mm (r) for medium seeded maize hybrid MAH 14-138 against recommended size of 6.4/7.0 mm (r).

**Crop: Pigeon pea**

Optimum sieve size for grading of pigeon pea variety NAAM 88 (small seeded) was maintained 3.2 mm (r) as recommended. For medium seeded pigeon pea variety BSMR 853, optimum sieve size of 4.0 mm (r) was maintained as recommended; whereas for medium seeded PDKV Ashlesha, grading sieve size of 4.75 mm (r) was recommended against the recommended sieve size of 4.0 mm (r). Optimum sieve size for grading of bold seeded pigeon pea variety BRG-5 was found to be 5.0 mm (r). Sieve size of 4.75 mm (r) was maintained for bold seeded varieties viz., Maruti and AKT 8811 as recommended; whereas, for bold seeded variety Phule Trupti, 4.75 mm (r) and 5.00 mm (r) sieve sizes were standardized at PDKV, Akola and MPKV, Rahuri, respectively.

**Crop: Green gram**

Optimum grading sieve size was maintained as 3.20 mm (s) for the medium seeded green gram variety VBN 7 as recommended. The grading sieve size of 2.40 mm (s) was standardized for better grading of the small seeded green gram variety Virat against the recommended sieve size of 2.80 mm (s).

**Crop: Black gram**

Optimum grading sieve size was found to be 2.50 mm (s) for black gram variety VBN 12 evaluated at PAJANCOA & RI, Karaikal. Grading sieve size of 2.75 mm (s) was found to be optimum for black gram variety DBGV 5 against the recommended sieve size of 2.80 mm (s).

**Crop: Sorghum**

Optimum grading sieve size was found to be 3.75mm (r) for the sorghum varieties Phule Suchitra (bold seeded) and Phule Revati (medium seeded) against the recommended sieve size of 3.50mm (r). For Phule Yashomati (medium seeded), the optimum grading sieve size was standardized to be 3.50 mm (r) as recommended.

**Crop: Millets**

In case of finger millet, optimum grading sieve size of 0.60 mm (s) was standardized for better grading of variety Indravati against the recommended sieve size of 1.40 mm (s). The grading sieve size was found to be 1.2 mm (r) for finger millet varieties, KMR 630 and ML-322 against the recommended sieve size of 1.40 mm (s). Similarly, 1.40 mm (s) sieve size was maintained for finger millet varieties CO 15, Hagari ragi 13 and Phule Nachani as recommended.

In case of barnyard millet, 1.30 mm (s) and 1.20 mm (s) grading sieve sizes were found to be optimum for the varieties MDU 1 and HU-1, respectively, against the recommended sieve sizes of 1.40 mm (s)/1.80 mm (r). In case of kodo millet, optimum grading sieve size of 1.60 mm (s) was found to be optimum for the varieties ATL 1 and Hagari Haraka 1 against the recommended sieve sizes of 1.60 mm (s)/2.00 mm (r). In case of foxtail millet, grading sieve size of 1.30 mm (r), 1.20 mm (s) and 1.10 mm (s) was found to be optimum for the varieties GPUF-28, HN 46 and ATL 2, respectively, against the recommended sieve sizes of 1.20 mm (s)/1.30 mm (r). In case of proso millet, grading sieve size of 1.20 mm (s) was found to be optimum for the variety HB 1 against the recommended sieve size of 1.60 mm (s). In case of brown top millet, optimum grading sieve size of 1.20 mm (r) was found to be optimum for the variety GPUBT-2. In case of little millet, optimum grading sieve size of 1.00 mm (r) was found to be optimum for the GPUL-6 against the recommended sieve size of 1.60 mm (r).

**Crop: Sunflower**

Optimum grading sieve size was found to be 2.80 mm (s) for parental line RHA 763 of sunflower hybrid KBSH-90, whereas 2.60 mm (s) sieve size was found optimum for the parental line CMS 207 A (the female parental line of KBSH-90) against the recommended sieve size of 2.40 mm (s).

**Crop: Forage crops**

In case of forage crops, optimum grading sieve size of 0.8 × 20 mm (s), 0.7 × 20 mm (s) and 1.8 mm (r) was recommended for Lucerne cv. DL 5, Guinea grass cv. DGG-1 and Verano (*Stylosanthes hamata*), respectively. Optimum sieve size of 2.0 mm (r) was standardized for fodder sorghum cv. CoFS-29 and TNDV-1 (*Desmanthus virgatus*). Optimum sieve size of 2.1 mm (r) and 2.2 mm (r) was standardized for other forage crop varieties such as DBRS-1 (*Brachiaria ruziziensis*) and Siratro (*Macroptilium atropurpureum*), respectively.

**Table 5.1: Crop & variety wise screen size optimized for grading of seeds**

| Centre | Crop / Seed size (categories) | Variety | Sieves used (mm) | IMSC Recommended Sieve Size (mm) | Standardized Sieve Size (mm) | Seed Recovery (%) |
|---|---|---|---|---|---|---|
| | **Paddy** | | | | | |
| **ICAR-IARI RS, Karnal** | Medium slender | PB 1985 | 2.2 s, 2.1 s, 1.9 s, 1.8 s, 1.6 s | 1.80 s | 1.80 s | 95.08 |
| | Medium slender | PB 1979 | | | 1.80 s | 91.70 |
| | Medium slender | PB 1692 | | | 1.80 s | 95.69 |
| | Medium slender | PB 1847 | | | 1.90 s | 97.24 |
| | Medium slender | PB 1885 | | | 1.80 s | 90.15 |
| **ICAR-NISST, Mau** | Fine seeded | Pusa Narendra Kala Namak 101 | 1.7 s, 1.6 s, 1.5 s, 1.4 s, 1.3 s | 1.70 s | 1.50 s | 80.60 |
| **TNAU, Coimbatore** | Bold seeded | ADT 59 | 2.2 s, 2.0 s, 1.85 s, 1.8 s, 1.7 s | 1.85 s | 1.85 s | 97.00 |
| | Medium Slender | CO 59 | 1.7 s, 1.65 s, 1.6 s, 1.55 s, 1.5 s | 1.80 s | 1.60 s | 95.70 |
| **PAJANCOA & RI, Karaikal** | Long bold | KKL(R) 3 | 2.0 s, 1.8 s, 1.7 s, 1.6 s | 1.85 s | 1.80 s | 90.20 |
| | Fine seeded | ADT(R) 54 | 1.8 s, 1.7 s, 1.6 s, 1.55 s | 1.70 s | 1.55 s | 93.30 |
| | Fine seeded | ADT(R) 58 | 1.7 s, 1.65 s, 1.6 s, 1.55 s | 1.70 s | 1.55 s | 94.90 |
| **PDKV, Akola** | Short slender | PDKV Ganesh | 1.85 s, 1.8 s, 1.6 s, 1.4 s | 1.70 s | 1.60 s | 90.50 |
| | Short slender | PDKV Sakoli (Red Rice) 1 | 1.8 s, 1.6 s, 1.4 s, 1.2 s | 1.70 s | 1.40 s | 98.70 |
| | Long slender | PDKV Sadhana | 1.85 s, 1.8 s, 1.6 s | 1.85 s | 1.80 s | 94.50 |
| | Long slender | Sakoli 8 | 2.0 s, 1.85 s, 1.8 s, 1.6 s | 1.85 s | 1.80 s | 95.80 |
| | Short bold | SYE 2001 | 2.0 s, 1.85 s, 1.8 s | 1.85 s | 1.85 s | 97.90 |
| **PAU, Ludhiana** | Long slender | PR 132 | 2.3 s, 2.2 s, 2.1 s, 2.0 s,1.9 s | 1.85 s | 2.10 s | 95.40 |
| | | | | | | |
| **PJTSAU, Hyderabad** | Long slender | MTU 1010 | 2.3 s, 2.0 s, 1.9 s, 1.85 s, 1.8 s | 1.85 s | 1.85 s | 91.80 |
| | Bold seeded | MTU 1001 | | 1.85 s | 1.85 s | 89.03 |
| | Bold seeded | MTU 7029 | 2.0 s, 1.85 s, 1.8 s, 1.7 s, 1.65 s | 1.85 s | 1.65 s | 99.11 |
| | Medium slender | BPT 5204 | 1.9 s, 1.8 s, 1.7 s, 1.65 s, 1.55 s | 1.80 s | 1.55 s | 99.85 |
| | Medium slender | KNM 1638 | | 1.80 s | 1.55 s | 99.70 |
| | Short slender | RNR 15048 | 1.9 s, 1.8 s, 1.7 s, 1.6 s, 1.5 s | 1.70 s | 1.50 s | 99.71 |
| | **Wheat** | | | | | |
| **ICAR-IARI, RS, Karnal** | Bold seeded | HD 3385 | 3.2 s, 2.8 s, 2.4 s, 2.2 s, 2.1 s | 2.30 s | 2.40 s | 89.29 |
| | Bold seeded | HD 3386 | | 2.30 s | 2.40 s | 91.2 |
| | Bold seeded | HD 3406 | | 2.30 s | 2.40 s | 96.96 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Bold seeded | HD 3249 | | 2.30 s | 2.40 s | 90.91 |
| **ICAR-NISST, Mau** | Bold seeded | DBW 187 | 2.8 s, 2.5 s, 1.8 s | 2.30 s | 1.80 s | 96.97 |
| | Bold seeded | HD2967 | 2.9 s, 2.8 s, 2.5 s, 2.0 s, 1.8 s | 2.30 s | 2.00 s | 94.48 |
| **SHUATS, Prayagraj** | Bold seeded | AAIW6 | 2.75 s, 2.5 s, 2.25 s, 2.0 s | 2.30 s | 2.50 s | 86.50 |
| | Bold seeded | AAIW15 | | 2.30 s | 2.50 s | 84.50 |
| | Bold seeded | AAIW52 | | 2.30 s | 2.50 s | 87.00 |
| | Medium seeded | AAIW9 | | 2.10 s | 2.25 s | 88.50 |
| | Medium seeded | AAIW10 | | 2.10 s | 2.25 s | 87.00 |
| | Medium seeded | AAIW13 | | 2.10 s | 2.25 s | 89.50 |
| **PAU, Ludhiana** | Bold seeded | PBD 872 | 2.5 s, 2.4 s, 2.3 s, 2.1 s, 1.9 s | 2.30 s | 2.30 s | 92.00 |
| | **Mustard** | | | | | |
| **ICAR-IARI, RS, Karnal** | Medium seeded | PM 34 | 2.4 r, 2.1 r, 2.0 r, 1.7 r, 1.5 r | 0.90/1.00s/1.4r | 1.7 r | 94.02 |
| | Medium seeded | PM 32 | | 0.90/1.00 s | 1.7 r | 95.37 |
| | **Chickpea** | | | | | |
| **UAS, Dharwad** | Medium seeded | BGD 204 | 7.25 r, 6.5 r, 6.0 r, 5.5 r, 5.0 r | 5.50 r | 5.50 r | 82.76 |
| **PDKV, Akola** | Medium seeded | PDKV Harita | 7.0 r, 6.5 r, 6.0 r, 5.5 r | 5.50 r | 6.00 r | 95.90 |
| | Medium seeded | Super Jaki | 7.5 r, 7.0 r, 6.5 r, 6.0 r, 5.5 r | 5.50 r | 6.00 r | 98.50 |
| | Medium seeded | PDKV Kanak (AKG 1303) | 7.5 r, 7.0 r, 6.5 r, 6.0 r, 5.5 r | 5.50 r | 6.00 r | 96.00 |
| | Bold seeded | PDKV Kabuli-2 | 8.5 r, 8.0 r, 7.5 r, 7.0 r, 6.5 r, 6.0 r | 6.00 r | 7.00 r | 88.60 |
| | Extreme bold seeded | PDKV Kabuli-4 | 10.0 r, 9.5 r, 9.0 r, 8.5 r, 8.0 r, 7.5 r | 6.00 r | 8.00 r | 95.00 |
| | **Soybean** | | | | | |
| **UAS, Dharwad** | Medium seeded | DSb 34 | 4.4 s, 4.3 s, 4.0 s, 3.75 s, 3.5 s | 4.00 s | 3.75 s | 92.96 |
| **UAS, Raichur** | Medium seeded | DSb 34 | 4.4 s, 4.2 s, 4.0 s, 3.8 s, 3.6 s | 4.00 s | 3.80 s | 91.55 |
| **PDKV, Akola** | Medium seeded | PDKV Amba | 4.5 s, 4.0 s, 3.6 s, 3.2 s | 4.00 s | 4.00 s | 89.50 |
| | Medium seeded | Suvarna Soya | | 4.00 s | 4.00 s | 88.30 |
| | **Soybean (Veg.)** | | | | | |
| **UHS, Bagalkote** | Bold seeded | Krishna prabha Pinakini | 4.8 s,4.6 s, 4.4 s, 4.0 s | 4.00 s | 4.60 s | 97.00 |
| | **Chilli** | | | | | |
| **UHS, Bagalkote** | - | Krishna Prabha Rudra | 2.5 r, 2.4 r, 2.1 r, 2.0 r | 2.10 r | 2.50 r | 94.40 |
| | **Maize** | | | | | |
| **UAS, Bengaluru** | Medium seeded | MAH 14-138 | 7.0 r, 6.75 r, 6.5 r, 6.25 r, 6.0 r | 6.40/7.00 r | 6.50 r | 94.30 |
| | **Pigeon pea** | | | | | |
| **UAS, Bengaluru** | Bold seeded | BRG-5 | 6.0 r, 5.5 r, 5.0 r, 4.75 r, 4.5 r | 4.75 r | 5.00 r | 91.46 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **PDKV, Akola** | Medium seeded | BSMR 853 | 4.75 r, 4.5 r, 4.0 r, 3.5 r | 4.00 r | 4.00 r | 96.66 |
| | Medium seeded | PDKV Ashlesha | 5.5 r, 5.0 r, 4.75 r, 4.5 r | 4.00 r | 4.75 r | 98.01 |
| | Bold seeded | Maruti | 5.5 r, 5.0 r, 4.75 r, 4.5 r, 4.0 r | 4.75 r | 4.75 r | 83.30 |
| | Bold seeded | AKT 8811 | 5.5 r, 5.0 r, 4.75 r, 4.5 r | 4.75 r | 4.75 r | 92.97 |
| | Bold seeded | Phule Trupti | 5.5 r, 5.0 r, 4.75 r, 4.5 r | 4.75 r | 4.75 r | 98.04 |
| **UAS, Raichur** | Small seeded | NAAM 88 | 3.6 r, 3.4 r, 3.2 r, 3.0 r, 2.8 r | 3.20 r | 3.20 r | 91.50 |
| **MPKV, Rahuri** | Bold seeded | Phule Trupti | 5.5 r, 5.25 r, 5.0 r, 4.75 r, 4.5 r | 4.75 r | 5.00 r | 94.18 |
| | **Green gram** | | | | | |
| **ICAR-NISST, Mau** | Small seeded | Virat | 3.3 s, 3.2 s, 3.1 s, 3.0 s, 2.8 s, 2.4 s | 2.80 s | 2.40 s | 99.35 |
| **PAJANCOA & RI, Karaikal** | Medium seeded | VBN 7 | 3.4 s, 3.2 s, 3.0 s | 3.20 s | 3.20 s | 94.40 |
| | **Black gram** | | | | | |
| **UAS, Dharwad** | Medium seeded | DBGV 5 | 3.2 s, 3.0 s, 2.8 s, 2.75 s, 2.5 s | 2.80 s | 2.75 s | 85.76 |
| **PAJANCOA & RI, Karaikal** | Bold seeded | VBN 12 | 3.4 s, 3.2 s, 3.0 s, 2.8 s, 2.7 s, 2.5 s, 2.2 s | 2.80 s | 2.50 s | 93.60 |
| | **Sorghum** | | | | | |
| **MPKV, Rahuri** | Bold seeded | Phule Suchitra | 4.5 r, 3.75 r, 3.5 r, 3.25 r, 3.0 r | 3.50 r | 3.75 r | 90.79 |
| | Medium seeded | Phule Revati | | 3.50 r | 3.75 r | 90.89 |
| | Medium seeded | Phule Yashomati | | 3.50 r | 3.50 r | 94.82 |
| | **Field bean** | | | | | |
| **UAS, Bengaluru** | Medium seeded | HA-5 | 7.0 r, 6.5 r, 6.0 r, 5.5 r, 5.0 r | 4.75 s | 6.00 r | 93.25 |
| | **Finger millet** | | | | | |
| **ICAR-NISST, Mau** | - | Indravati | 1.5 s, 1.4 s, 1.3 s, 1.2 s, 1.1 s, 0.6 s | 1.40 s | 0.60 s | 99.65 |
| **UAS, Bengaluru** | - | KMR 630 | 1.4 r, 1.3 r, 1.2 r, 1.1 r, 1.0 r | 1.40 s | 1.20 r | 91.16 |
| | - | KMR ML-322 | | 1.40 s | 1.20 r | 92.37 |
| **TNAU, Coimbatore** | - | CO 15 | 1.6 s, 1.5 s, 1.4 s, 1.3 s, 1.25 s | 1.40 s | 1.40 s | 92.20 |
| **UAS, Raichur** | - | Hagari ragi 13 | 1.8 s, 1.6 s, 1.4 s, 1.2 s, 1.0 s | 1.40 s | 1.40 s | 90.39 |
| **MPKV, Rahuri** | - | Phule nachani | 1.5 s, 1.4 s, 1.3 s, 1.2 s, 1.1 s | 1.40 s | 1.40 s | 91.38 |
| | **Barnyard millet** | | | | | |
| **TNAU, Coimbatore** | - | MDU 1 | 1.6 s, 1.5 s, 1.4 s, 1.3 s, 1.25 s | 1.40 s, 1.80 r | 1.30 s | 96.10 |
| **UAS, Raichur** | - | HU-1 | 1.8 s, 1.6 s, 1.4 s, 1.2 s, 1.0 s | 1.40 s, 1.80 r | 1.20 s | 88.61 |
| | **Kodo millet** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **TNAU, Coimbatore** | - | ATL 1 | 1.8 s, 1.7 s, 1.6 s, 1.5 s, 1.4 s | 1.60 s, 2.00 r | 1.60 s | 90.00 |
| **UAS, Raichur** | - | Hagari haraka 1 | 2.0 s, 1.8 s, 1.6 s, 1.4 s, 1.2 s | 1.60 s, 2.00 r | 1.60 s | 86.37 |
| | **Foxtail millet** | | | | | |
| **TNAU, Coimbatore** | - | ATL 2 | 1.4 s, 1.3 s, 1.2 s, 1.1 s, 1.0 s | 1.20 s, 1.30 r | 1.10 s | 97.50 |
| **UAS, Raichur** | - | HN 46 | 1.6 s, 1.4 s, 1.2 s, 1.0 s, 0.8 s | 1.20 s, 1.30 r | 1.20 s | 88.30 |
| **UAS, Bengaluru** | - | GPUF-28 | 1.5 r, 1.4 r, 1.3 r, 1.2 r, 1.1 r | 1.20 s, 1.30 r | 1.30 r | 91.55 |
| | **Proso millet** | | | | | |
| **UAS, Raichur** | - | HB 1 | 1.6 s, 1.4 s, 1.2 s, 1.0 s, 0.8 s | 1.60 s | 1.20 s | 81.80 |
| | **Brown top millet** | | | | | |
| **UAS, Bengaluru** | - | GPUBT-2 | 1.3 r, 1.2 r, 1.1 r, 1.0 r, 0.9 r | - | 1.20 r | 82.57 |
| | **Little millet** | | | | | |
| **UAS, Bengaluru** | - | GPUL-6 | 1.3 r, 1.2 r, 1.1 r, 1.0 r, 0.9 r | 1.60 r | 1.00 r | 94.13 |
| | **Sunflower** | | | | | |
| **UAS, Bengaluru** | Medium seeded | CMS 207 A | 3.0 s, 2.8 s, 2.6 s, 1.85 s, 1.8 s | 2.40 s | 2.60 s | 92.67 |
| | Medium seeded | RHA 763 | 3.25, 3.0, 2.8, 2.4, 1.85 s | 2.40 s | 2.80 s | 91.13 |
| | **Forage crops** | | | | | |
| | | | | | | |
| **IGFRI, SRRS, Dharwad** | Lucerne | DL 5 | 0.7 s, 0.8 s, 0.9 s, 0.7 r, 0.8×20 s | 0.7×0.7×0.7 m | 0.8×20 s | 92.90 |
| | Guinea grass | DGG-1 | 2.6×0.8, 2.5×0.7, 2.4×0.65, 0.7×20 s, 0.6 r | 2.4×0.65 m | 0.7 x 20 s | 94.54 |
| | Fodder sorghum | CoFS-29 | 2.3 s, 2.2 s, 2.1 s, 2.1 r, 2.0 r | 2.10 s | 2.00 r | 95.30 |
| | *Stylosanthes hamata* | Verano | 2.0 r ,1.9 r,1.8 r, 1.6 r | - | 1.80 r | 84.61 |
| | *Brachiaria ruziziensis* | DBRS-1 | 2.20 r,2.10 r,2.0 r, 1.80 r | - | 2.10 r | 90.65 |
| | *Desmanthus virgatus* | TNDV-1 | 2.10 r,2.0 r, 1.8 r, 1.7 r | - | 2.00 r | 93.68 |
| | *Macroptilium atropurpureum* | Siratro | 2.2 r,2.1 r, 1.9 r, 1.8 r | - | 2.20 r | 92.00 |

❖ **Experiment 2: Performance evaluation of solar tunnel dryer for drying of soybean seed**

- Soybean seed drying in a solar tunnel dryer resulted in faster moisture reduction compared to sun drying, demonstrating improved drying efficiency.
- In high-moisture seeds, solar drying reached comparable moisture levels nearly one day earlier than sun drying, indicating a shorter drying duration and clear operational advantage in terms of efficiency, and economic benefit.
- Seeds with initial moisture content below 15% showed better retention of quality parameters irrespective of drying process.
- In contrast, seeds with initial moisture content above 15% required longer drying duration to reach safe storage moisture, during which quality parameters gradually declined due to extended exposure to drying conditions.
- Although solar tunnel drying facilitated faster moisture loss, prolonged exposure to elevated temperatures (up to 44.3 °C compared to ambient 35.3 °C) resulted in comparatively lower seed quality parameters than sun drying.
- It can be concluded that, although sun drying was superior in maintaining germination, seed weight, vigour, and physical purity under normal conditions. But solar drying proved more effective during the rainy season due to its ability for rapid and efficient moisture removal under adverse weather conditions. Therefore, solar drying can be recommended as a reliable alternative to sun drying in rainy periods for preserving soybean seed quality.

❖ **Experiment No. 3: Impact of seed size on seed germination and yield of soybean**

- The seed yield obtained with seed graded with 4.00 and 3.60mm sieves was statistically similar; however, both sieve sizes consistently produced higher seed yield than 3.20 mm sieve.
- Grading of seed with 4.00 mm sieve consistently resulted in higher seed yield compared to 3.60 mm and 3.20 mm sieves. The increase in seed yield with 4.00 mm sieve over 3.60 mm sieve ranged from 3.98 to 17.48%, whereas increase over 3.20 mm sieve ranged from 10.62 to 58.05%, indicating that retention of bolder seeds through larger sieve size significantly enhanced crop productivity.
- In case of germination, the increase in germination with 4.00 mm sieve over 3.60 mm sieve varied from 0.26 to 9.77%, whereas improvement over 3.20 mm sieve ranged from 2.3 to 24.74%.
- Similarly, field emergence percentage was higher with 4.00 mm sieve compared to 3.60 mm and 3.20 mm sieves. The increase in field emergence with 4.00 mm sieve over 3.60 mm sieve was up to 12.61%, whereas increase over 3.20 mm sieve ranged from 8.30% to 30.15%.
- The increase in number of pods per plant with 4.00 mm sieve over 3.60 mm sieve ranged from 0.80 to 18.58%, whereas increase over 3.20 mm sieve ranged from 6.16 to 33.33%.

- However, the number of seeds per pod and seed weight was only marginally influenced by sieve size.
- Overall, seed grading with a 4.00 mm sieve was numerically superior to the 3.60 mm sieve in terms of yield and yield-attributing traits; however, the differences were statistically at par. This highlights the importance of retaining bolder seeds for improved crop establishment and productivity, while also indicating the potential for reducing sieve size under poor seed production conditions.

# Recommendations of Seed Technology Research 2024-25

The discipline-wise recommendations made under the seed technology research component of AICRP on Seed (Crops) during 2024-25 are compiled and presented below.

## A. Seed Physiology, Storage and Testing

### 1. Reaffirming the validity periods for seed certification in castor, sorghum and small millets

**Introduction:** Regarding the General Seed Certification Standards of IMSCS, the validity period shall be nine months from the test date at the time of initial certification. Based on the request, SSCAs may provide one-time revalidation for a period of six months from the date of the test, subject to strict adherence to prescribed seed standards. However, based on prevailing ambient storage conditions and the inherent storage potential of crop species, the seed longevity during storage varies. The purpose of the current study was to determine crop species-wise seed storage potential and validity periods.

**Technique:** Cooperating centers have reviewed and determined the validity period for certified castor, sorghum, pearl millet, finger millet, barnyard millet, foxtail millet and proso millet seeds. Based on the lower limit of the range of average results obtained across centers, excluding statistical outliers, the validity period has been established (detailed in table below). In this context, it is recommended that only the initial validity period be granted, and further revalidation for castor crop seed lots may be considered after seed testing at NABL-accredited lab/ notified STL.

| **Crops** | **Recommendations on maximum period maintaining germination percent above IMSCS** |
|---|---|
| Castor | 11 months of Germination >70% |
| Pearl Millet | 6 months under ambient storage |
| Sorghum | 12 months or revalidation for 3 months after initial certification for 9 months (subject to germination % above IMSCS) |
| Finger Millet | 12 months or revalidation for 3 months after initial certification for 9 months (subject to germination % above IMSCS) |
| Barnyard Millet | 15 months or revalidation for 6 months after initial certification for 9 months (subject to germination % above IMSCS) |
| Foxtail Millet | 15 months or revalidation for 6 months after initial certification for 9 months (subject to germination % above IMSCS) |

**Conclusion:** Based on the storability studies conducted under ambient conditions across diverse locations, the validity period for initial seed certification in all crops above has been reaffirmed as 9 months from initial testing. However, further revalidation is recommended only after seed testing at NABL-accredited/notified STL, in order to safeguard against potential crop failures that may arise due to unwarranted seed deterioration in lots stored under varying agro-climatic conditions.

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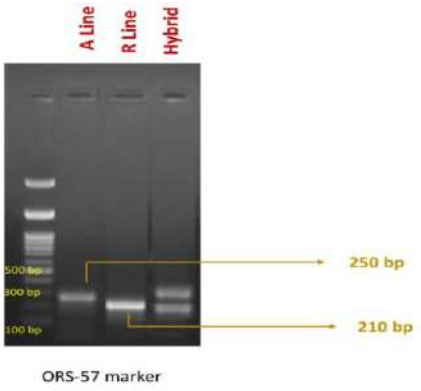
**PI/ Co-PI:** Dr. Shiv K. Yadav, ICAR-IARI, RS, Karnal/ Dr. Udaya Bhaskar K., ICAR-NISST, Mau

**2. Rapid assessment of genetic purity through molecular markers in maize, sunflower, castor and sorghum hybrids**

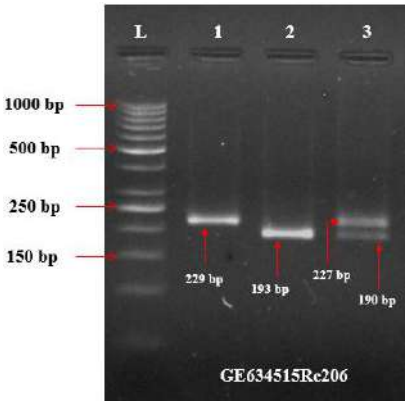
**Introduction:** Among various seed quality parameters, genetic purity holds utmost importance for realizing the full yield potential of any crop. Ensuring a high level of genetic purity in hybrid seed lots is particularly challenging, yet critical for harnessing heterosis. As per the IMSCS, 2013, the minimum acceptable genetic purity is 85% for hybrid castor, 90 % for cotton hybrids and 95% for hybrids of other crops. Currently, the Grow-Out Test (GOT) is the standard procedure to assess genetic purity. However, GOT is resource-intensive, requiring an entire cropping season, substantial land, and labour, and it is subject to environmental influence on plant phenotypes, affecting accuracy and increasing costs. In this context, the use of molecular markers offers a promising alternative. Marker-based assays provide accurate, rapid, and reproducible results and are not influenced by environmental conditions, making them a viable and efficient tool for genetic purity testing in hybrid seed production systems.

**Technique:** Cooperating centres have identified simple sequence repeat (SSR) markers for genetic purity assessment of hybrid seed lots in crops, viz., maize, sunflower, castor and sorghum. These unique markers have been validated across the centers for reproducibility. The crop and hybrid-wise list of identified/validated unique SSR markers is given below.

| Crop | Hybrid | Parental lines (M*F) | Markers recommended for hybridity testing |
|---|---|---|---|
| Maize | PMH -13 | LM 17 * LM 27 | PHI 053 |
| | PMH- 14 | LM 29 * LM 28 | UMC 2520, UMC1656, UMC1066, BNLG2122 and BNLG1754 |
| | SMH-3 | NAI 137 * MAI 729 | BNLG1523 and PHI 1523 |
| | SMH-5 | BML 6 * IML 187 | BNLG 1666 |
| Sunflower | KBSH -78 | RHA 92 * CMS 1103A | ORS- 57 and ORS-170 |
| | KBSH-85 | RHA 756 * CMS 903A | ORS- 598 |
| Castor | GNCH-1 | DCS 94 * SKP 84 | GE634515Rc206 |
| | NAUCH-22-1 | - | EG666840Rc90, GE634515Rc206 |
| Sorghum | AKSH 727 | AKR 545 * AKMS 30A | SB6-32 and SB6-42 |




SSR profiling with primer ORD-57 in KBSH-78 sunflower hybrid




SSR profiling with primer GE634515Rc206 in GNCH-1 castor hybrid

**Fig.1: Amplification among parental lines and genetic purity assessment in field crops**

**Conclusion:** The technique developed will enable rapid and faster determination of genetic purity, reduce time and labour, and also provide reproducible results for genetic purity assessment.

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**3. Seed biopriming enhances the planting value of paddy seed under both optimal and sub-optimal conditions in an organic production system.**

**Introduction:** Seed priming, particularly biopriming, is an eco-friendly and cost-effective strategy for seed enhancement. Microbes colonize the rhizosphere and interact synergistically with plant roots, enhancing seedling establishment, promoting robust plant growth, and ultimately contributing to improved yield. Biopriming offers protection against a range of biotic and abiotic stresses, aligning well with sustainable agriculture principles by serving as an effective alternative to chemical treatments. They exert their beneficial effects through both direct and indirect mechanisms. Directly, they enhance nutrient acquisition (e.g., nitrogen, phosphorus, and other essential elements) and modulate phytohormone levels to stimulate growth. Indirectly, they function as biocontrol agents by inducing systemic resistance, producing antifungal metabolites, and suppressing pathogenic organisms.

**Technique:** Several biopriming agents, including Metajal and Trichojal obtained from AAU, Anand, were evaluated for their efficacy. Seed treatment with these bioformulations at specific concentrations, led to significant improvements in seed yield and quality under both optimal and sub-optimal environmental conditions in organic production system in paddy. Referred treatment combinations fared better across multiple locations.

| Crop | Priming technology standardized/ validated/ demonstrated |
|---|---|
| Paddy (organic) | Seed treatment with Metajal or Trichojal @ 5 ml/kg seed before sowing. Seeds primed with Metajal @ 5 ml/kg of seed performed better in terms of seed vigour as well as seed yield and yield attributes viz., 8.6% higher number of filled grains / panicle, 9.6% higher test weight, 23.8% increased seed yield / plot and 21% enhanced harvest index was reported |

**Conclusion:** Seed biopriming has emerged as a widely adopted technique among diverse stakeholders for enhancing seed vigour, particularly in terms of germination potential and stress tolerance. Notable improvements in early seedling vigour, optimal plant stand establishment, and final seed yield were observed following seed biopriming.

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**4. Mitigation of terminal heat stress for better seed yield and quality in chickpea and finger millet**

**Introduction:** Climate change is rapidly altering agro-ecosystems and threatens food availability. Heat (high temperature) stress is emerging as a major abiotic constraint under current and future climate scenarios. Although it affects crops at all growth stages, damage during the reproductive phase, particularly the seed-filling stage, is most critical, leading to significant yield losses and deterioration in seed quality. Heat stress reduces seed size and number, thereby affecting key commercial traits such as 1000-seed weight. Improving seed yield and quality under such stress requires integrated approaches combining genetic improvement and agronomic management. The exogenous application of stress-alleviating compounds, including plant growth regulators and signaling molecules, offers a promising strategy to enhance crop performance and seed quality under high-temperature conditions.

**Technique:** The spraying of cycocel at 1000 ppm two times i.e. first at vegetative stage and second at anthesis stage overcame the adverse effects of heat stress on seed yield and quality in chickpea. Similarly, foliar spray of thiourea at 400 ppm at vegetative stage mitigated the adverse effects of terminal heat stress in finger millet. Influence of terminal heat stress on seed set, seed yield, and quality, with successful demonstrations of the below-referred technologies in mentioned crops were conducted.

| Crops | Recommended Technology | Remarks |
|---|---|---|
| Chickpea | Foliar spraying of Cycocel @ 1000 ppm at vegetative | Under late sown and very late sown conditions, Cycocel sprayed plots recorded with 173.50 kg |

| | | |
|---|---|---|
| | stage, followed by the anthesis stage | and 139.33 kg per plot showing 12.30 and 9.71 percent enhancement over control, respectively. |
| Finger millet | Foliar spraying of Thiourea @ 400 ppm at vegetative stage | Thiourea spray @ vegetative phase showed the highest seed set percentage (94.30%) and yield (1085.90 kg/acre), demonstrating its effectiveness in mitigating heat stress while control plots exhibited lower performance, with a yield of 738.70 kg/acre. |

**Conclusion:** Simple spraying of cycocel in chickpea and thiourea in finger millet led to a physiological state that enabled the plant to reverse the deleterious effect of heat stress coinciding the flowering, seed set and filling stage. The usefulness of spraying of cycocel and thiourea as foliar sprays were found to mitigate the influence of terminal heat stress on seed set, yield, and quality and same was validated and demonstrated on large scale. The technology would benefit seed production agencies at large.

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**B. Seed Pathology**

**1.Seed health standards for *A. carthami* in safflower for seed certification**

**Introduction:** Seed-borne pathogens pose a serious threat to safflower cultivation by affecting germination, seedling vigor, and overall crop productivity. *Alternaria carthami*, the causal agent of Alternaria leaf blight, is one of the most important seed-transmitted pathogens in safflower. Infected seeds serve as a primary source of inoculum, leading to field-level disease outbreaks. Therefore, establishing scientifically validated seed health standards is essential to ensure the production and distribution of disease-free, high-quality seeds.

**Technique:** Seed samples with varied level of infection by *Alternaria carthami* were used in the present study. The level of infection was later corelated with the disease incidence and transmission in later generations through seed.

| Crops | Pathogen | Recommended Technology |
|---|---|---|
| Safflower | *Alternaria carthami* | Seed standard for foundation seed based on maximum per cent seed infection of *Alternaria carthami* in safflower may be recommended as 0.1 per cent. |

**Conclusion:** Based on experimental findings, a maximum permissible seed infection level of 0.1% is recommended for foundation seed. This threshold will help ensure better seed health, reduce disease incidence in the field, and support sustainable safflower seed production system and ensure supply of disease-free planting material to the farmers.

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**2. Potato dextrose agar plate method recommended for detecting seed borne infections in sesame**

**Introduction:** Seeds are basic and most important input in agriculture. Disease causing agents viz. fungi, bacteria, nematodes and viruses may be carried with, on or in seeds and can potentially cause huge economic losses. Seed health is one of the quality parameters seed certification system. In order to supply disease free planting material, it is imminent to have quick, robust and reliable protocols for detection of seed borne pathogens. Testing seeds before sowing will identify potential disease problems and allow for the planning of measures to reduce the disease risk.

**Technique/ Specification:** The experiment on development of detection methods for seed borne pathogens of economic importance has been ongoing since 2008. The potato dextrose agar plate method was found efficient in detection of seed borne infections in sesame.

| Method standardized | Pathogens | Crop | Protocol standardized in brief |
|---|---|---|---|
| Potato dextrose agar plate method | *Alternaria sesami* and *Macrophomina phaseolina* | Sesame | The potato dextrose agar (PDA) method found most efficient for detecting *Alternaria* (8.0%) and *Macrophomina* (11.5%), while the standard blotter method recorded 5.2% and 7.9%, respectively. |

**Conclusion:** Seed diagnosis can prevent the uncontrolled propagation of pathogens that cause economic losses. Conventional methods of seed diagnosis are frequently used because of their simplicity of application. In order to ensure the supply of high-quality seeds to end users, i.e., farmers, their application can be substantially extended in the future for the detection of pathogens in seeds.

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### 3. Management of paddy false smut through systemic fungicides

**Introduction:** False smut of rice, caused by *Ustilaginoidea virens*, has emerged as a significant disease affecting seed yield and quality. The pathogen infects florets during reproductive stages, leading to the formation of smut balls and contamination of seed lots. Effective management through systemic fungicides is essential for ensuring disease-free seed production. Identifying suitable fungicide combinations and application schedules plays a critical role in minimizing disease incidence and improving seed quality and productivity.

**Technique/ Specification:** Field and seed treatment trials were conducted using systemic fungicides. Treatments included seed dressing and two foliar sprays at panicle initiation and 50% flowering stages. Disease severity and yield parameters were recorded to evaluate the effectiveness of different fungicide combinations.

| Pathogens | Crop | Protocol standardized |
|---|---|---|
| False smut | Paddy | Trifloxystrobin 25% + Tebuconazole 50% WG (0.4g/lit for spray and 0.5 gm /kg seed for seed dressing) or Fluopyram 17.7% + Tebuconazole 17.7% SC (1ml/lit) applied as seed treatment and two foliar sprays, first at panicle initiation stage and second at early flowering stage (50% flowering) is recommended for reducing the severity of false smut disease and with higher seed yield and quality. |

**Conclusion:** Application of Trifloxystrobin 25% + Tebuconazole 50% WG or Fluopyram 17.7% + Tebuconazole 17.7% SC through seed treatment and two foliar sprays effectively reduces false smut severity and enhances yield and quality in rice seed production.

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### 4. Management of seed and seedling associated pathogens through fungicide seed treatment

**Introduction:** Seed and seedling-associated diseases caused by fungal pathogens significantly affect crop establishment, vigour, and productivity across major crops. Diseases such as wilt, root rot, charcoal rot, blast, and seed rot lead to poor germination and yield losses in seed production system. Seed treatment with systemic fungicides offers an effective strategy for early-stage disease management. The broad-spectrum effect of fungicide molecules was evaluated at multi-locations in various field crops and efficient treatments were identified and validated for ensuring healthy crop establishment and improved productivity.

**Technique/ Specification:** Multi-location trials were conducted across crops to evaluate seed dressing fungicides. Treatments were assessed for reduction in seedling infection, disease incidence, and improvement in field emergence and vigour index under field conditions.

| Crop | Disease | Method recommended |
|---|---|---|
| Pigeon pea | Wilt and Root rot | Seed treatment with Penflufen 13.28% + Trifloxystrobin 13.2%FS @1 ml / kg is recommended for management of multiple diseases (Fusarium wilt & Macrophomina charcoal rot) |
| Green gram and Black gram | Macrophomina root rot | Seed treatment with Penflufen 13.28% + Trifloxystrobin 13.2%FS @ 1 ml/ kg which is recommended for management of multiple diseases (Fusarium wilt & Macrophomina charcoal rot). |
| Groundnut | Collar rot, Seed rot | Seed treatment with Penflufen 13.28% + Trifloxystrobin 13.2%FS @ 1 ml / kg which is recommended for management of multiple diseases (Collar rot & Seed rot) |
| Soybean | Pod rot, Charcoal Rot, Anthracnose | Seed treatment with Penflufen 13.28% + Trifloxystrobin 13.2%FS @ 1 ml / kg is recommended for management of multiple diseases (Anthracnose & Macrophomina charcoal rot) |
| Paddy | Blast, False smut, Brown spot, Sheath rot, Bakanae | Seed treatment with Trifloxystrobin 25%+ Tebuconazole 50%WG @ 0.5g/ kg is recommended for management of multiple diseases (blast, brown spot, bakanae, false smut and sheath rot). |

**Conclusion:** Seed treatment with Penflufen 13.28% + Trifloxystrobin 13.2% FS @1 ml/kg and crop-specific fungicide combinations proved effective in reducing infection, improving seedling vigour, and ensuring better crop establishment and productivity.

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**C. Seed Entomology**

**1. Management of storage insect pests through neem-based formulations**

**Introduction:** Storage insects cause significant quantitative and qualitative losses in cereals and pulses during storage. Infestation leads to reduced seed weight, loss of viability, and

deterioration in seed quality. Eco-friendly and safe alternatives to chemical protectants are increasingly preferred. Neem-based formulations containing azadirachtin have emerged as effective botanical insecticides. Their use as seed treatments offers a sustainable approach for protecting stored seeds while maintaining germination and overall seed quality over extended storage periods.

**Technique:** Seeds of cereals and pulses were treated with neem formulations containing 10,000 ppm azadirachtin @ 7.5 ml/kg. Treated seeds were stored and periodically evaluated for insect infestation and germination percentage over time.

**Table 1- Effect of seed treatment with botanicals in cereals (Three years' pooled data of trials and one year demonstration)**

| Trt. | Crops | Paddy | | | | Sorghum | | | | Wheat | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | |
| | Storage duration | 6-9M | | 9M | | 6-9M | | 9M | | 6-9 M | | 9 M | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| T1 | Neemazal T/S @75ppm | 89 | 0.39 | 82 | 0.63 | 83 | 0.32 | 85 | 0.28 | 89 | 0.23 | 91 | 0.0 |
| T2 | Neemoz - Gold @75ppm | 88 | 0.47 | 83 | 0.44 | 82 | 0.52 | 86 | 0.32 | 86 | 1.22 | 90 | 1.25 |
| T3 | Deltamethrin @ 1ppm | 89 | 0.31 | 83 | 0.06 | 82 | 0.36 | 85 | 0.63 | 90 | 0.24 | 90 | 0.0 |
| T4 | Untreated control | 81 | 4.35 | 82 | 5.25 | 70 | 6.57 | 73 | 3.91 | 78 | 6.44 | 87 | 6.75 |
| B:C ratio of T1 for selling as seed | | | | 1.13 | | | | 2.00 | | | | 1.24 | |
| B:C ratio of T2 for selling as seed | | | | 1.25 | | | | 2.26 | | | | 1.40 | |

*G-Germination (%) & ID- insect damage (%)

**Table 2- Effect of seed treatment with botanicals in pulses (Three years' pooled data of trials and one year demonstration)**

| | **Crops** | **Pigeon pea** | | | | **Black gram** | | | | **Field pea** | | | | **Cowpea** | | | | **Green gram** | | | | **Chickpea** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Storage duration | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | |
| | | 6-9M | | 9 M | | 6-9M | | 6M | | 6 M | | 9 M | | | | | | | | | | | | | |
| | | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| T1 | Neemazal T/S @75ppm | 86 | 0.63 | 82 | 0.45 | 82 | 0.03 | 81 | 0.85 | 94 | 0.83 | 87 | 0.0 | 85 | 0.56 | 86 | 0.50 | 92 | 0.99 | 80 | 0.00 | 88 | 0.65 | 86 | 0.00 |
| T2 | Neemoz - Gold @75ppm | 84 | 1.01 | 85 | 0.52 | 82 | 0.02 | 83 | 0.67 | 93 | 1.17 | 87 | 0.0 | 84 | 0.65 | 86 | 0.45 | 90 | 1.45 | 81 | 0.00 | 88 | 0.55 | 86 | 0.04 |

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T3 | Deltamethrin @ 1ppm | 87 | 0.47 | 83 | 0.62 | 82 | 0.00 | 84 | 0.49 | 94 | 0.50 | 78 | 1.7 | 84 | 0.78 | 80 | 0.41 | 91 | 1.11 | 83 | 0.00 | 87 | 0.34 | 87 | 0.24 |
| T4 | Untreated control | 78 | 6.48 | 81 | 3.21 | 70 | 0.84 | 55 | 3.51 | 83 | 5.50 | 29 | 58.0 | 71 | 9.57 | 76 | 21.5 | 66 | 19.00 | 77 | 19.91 | 54 | 26.05 | 72 | 8.09 |
| B:C ratio of T1 for selling as seed | | | | 2.91 | | | | 2.54 | | | | 1.72 | | | | | 2.16 | | | | 2.00 | | | | 2.43 |
| B:C ratio of T2 for selling as seed | | | | 3.66 | | | | 2.87 | | | | 1.94 | | | | | 2.44 | | | | 2.26 | | | | 2.74 |

*G-Germination (%) & ID- insect damage (%)

**Conclusion:** Seed treatment with neem formulation (@7.5ml/Kg seed) effectively controlled storage insects up to 6–9 months without adversely affecting germination, providing a safe and sustainable option for seed storage in cereals and pulses.

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**2. Management of storage insect pests through novel insecticides**

**Introduction:** Storage insect pests cause severe losses in cereals and pulses by reducing seed quality, and market value. Effective and long-lasting protection during storage is essential to maintain seed quality. Spinetoram, a modern insecticide with very low mammalian toxicity (EPA Toxicity Category-IV), has shown promising results against a wide range of storage pests. Its use as a seed treatment offers a reliable solution for prolonged protection of stored seeds across diverse agro-climatic conditions without compromising seed quality.

**Technique:** Seeds were treated with Spinetoram @3 ppm a.i. (11.7% SC @25.6 mg/kg seed) and stored under varying agro-climatic conditions. Periodic observations were recorded for insect infestation levels and germination percentage over time.

**Table 3- Effect of insecticidal seed treatment on seed quality of cereals (Three years' pooled data of trials and one year demonstration)**

| Crops | Wheat | | | | Paddy | | | | Sorghum | | | | Pearl millet | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | |
| Storage duration | 9M | | 9M | | 9M | | 12M | | 9M | | 9 M | | 9M | | 6M | |
| Germination (G) | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| seed damage (ID) | | | | | | | | | | | | | | | | |
| Spinetoram @ 3ppm | 90 | 0.34 | 85 | 0.00 | 90 | 0.09 | 80 | 0.49 | 88 | 0.37 | 83 | 0.67 | 90 | 0.33 | 87 | 0.0 |
| Deltamethrin @ 1ppm | 90 | 0.67 | 82 | 0.62 | 89 | 1.01 | 79 | 0.86 | 87 | 2.17 | 76 | 2.67 | 88 | 2.67 | 88 | 0.0 |
| Untreated control | 85 | 2.31 | 62 | 2.53 | 84 | 4.3 | 78 | 4.39 | 76 | 11.6 | 60 | 19.7 | 83 | 8.67 | 86 | 6.2 |
| B:C Ratio considering seed damage | 0.40 | | 0.44 | | 0.67 | | 0.69 | | 3.18 | | 5.39 | | 4.07 | | 2.87 | |

*G-Germination (%) & ID- insect damage (%)

**Table 4- Effect of insecticidal seed treatment on seed quality of Pulses (Three years' pooled data of trials and one year demonstration)**

| Crops | Cowpea | | | | Green gram | | | | Chickpea | | | | Black gram | | | | Pigeon pea | | | | Field pea | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | | Trial | | Demonstration | |
| Storage duration | 9-12M | | 9-12 M | | 9-12 M | | 9 M | | 9-12 M | | 12 M | | 6M | | 9M | | 9M | | 12M | | 6-9M | | 9 M | |
| | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID | G | ID |
| Spinetoram @ 3ppm | 85 | 0.58 | 79 | 1.18 | 87 | 0.34 | 85 | 0.29 | 88 | 0.34 | 90 | 0.00 | 82 | 0.51 | 75 | 0.93 | 88 | 0.58 | 89 | 0.55 | 92 | 0.50 | 91.0 | 0.67 |
| Deltamethrin @ 1ppm | 83 | 1.30 | 79 | 2.49 | 85 | 0.97 | 81 | 4.68 | 86 | 1.51 | 89 | 0.00 | 82 | 0.63 | 69 | 1.29 | 85 | 2.09 | 88 | 0.51 | 93 | 0.67 | 78.7 | 16.0 |
| Untreated control | 64 | 24.3 | 66 | 19.6 | 62 | 17.5 | 79 | 16.96 | 74 | 18.9 | 81 | 27.8 | 68 | 3.91 | 48 | 4.53 | 78 | 5.15 | 68 | 4.09 | 86 | 10.17 | 26.0 | 62.3 |
| B:C Ratio considering seed damage | 7.32 | | 5.03 | | 7.66 | | 7.43 | | 6.63 | | 10.87 | | 1.98 | | 2.29 | | 3.19 | | 2.57 | | 2.19 | | 13.40 | |

*G-Germination (%) & ID- insect damage (%)

**Conclusion:** Seed treatment with Spinetoram (11.7% SC @25.6 mg/kg seed) provided effective control of storage insects up to 9-12 months across crops, without affecting germination, making it a suitable option for safe and long-term seed storage.

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## C. Seed Processing

### 1. Optimization of aperture size of bottom/ grading sieves for processing of new crop varieties

**Introduction:** The Varietal Replacement Rate (VRR) in field crops is steadily increasing through induction of new crop varieties into seed chain. Share of new varieties (< 5 years old) in total breeder seed indents in recent years are in increasing trend in crops viz. wheat, paddy, chickpea, pigeon pea, mung bean, soybean and groundnut. Mostly, new crop varieties are bred for enhanced crop productivity that means bolder seed size or higher no. of seeds/plant. So, in order to achieve better seed recovery (in terms of pure seed) and quality of seed (as set under IMSCS, 2013), during processing operations, aperture size of bottom/ grading sieves need to be realigned time and again. Use of optimized sieve sizes shall enhance the seed processing efficiency and cost economics of seed production programme per se.

**Optimized grading sieve size:** In order to optimize the bottom/ grading sieve size, several aperture sizes were tested for new varieties in crops viz. paddy, wheat, maize, chickpea, soybean, pigeon pea, black gram, dhaincha, field bean, sunflower sunnhemp and finger millet. Following modifications are derived from the data generated by different centers of AICRP on Seed (Crops) during 2024-25.

**Proposed modifications for Bottom/ Grading Screen**

| Centre | Crop / Seed size (categories) | Variety | IMSC Recommended Sieve Size (mm) | Standardized Sieve Size (mm) | Seed Recovery (%) |
|---|---|---|---|---|---|
| | **Paddy** | | | | |
| **ICAR-IARI RS, Karnal** | Medium slender | PB 1985 | 1.8 s | 1.90 s | 88.80 |
| | Medium slender | PB 1979 | | 1.80 s | 88.60 |
| | Medium slender | PB 1882 | | 1.80 s | 92.97 |
| | Medium slender | PB 1885 | | 1.80 s | 90.96 |
| **ICAR-NISST, Mau** | Medium slender | KN3 (Kala Namak) | 1.8 s | 1.60 s | 75.39 |
| **TNAU, Coimbatore** | Medium Slender | ADT 58 | 1.8 s | 1.55 s | 93.70 |
| | Medium Slender | CO 56 | 1.8 s | 1.55 s | 91.8 |
| **PAJANCOA & RI, Karaikal** | Medium slender | KKL(R) 2 | 1.9 s, 1.8 s | 1.60 s | 97.6 |
| | Long bold seeded | KKL(R) 3 | 1.9 s, 1.8 s | 1.80 s | 94.8 |
| **PDKV, Akola** | Fine seeded | PDKV Ganesh | 1.7 s | 1.60 s | 94.8 |
| | Medium slender | PDKV Sakoli (Red Rice) 1 | 1.8 s | 1.60 s | 98.5 |
| | Long slender | PDKV Sadhana | 1.85 s | 1.80 s | 96.6 |
| | Long slender | Sakoli 8 | 1.85 s | 1.80 s | 92.9 |

| | | | | | |
|---|---|---|---|---|---|
| **UAS, Raichur, Karnataka** | Long grain bold seeded | GNV 1109 | 1.85 s | 1.80 s | 95.02 |
| **PAU, Ludhiana** | Long slender | PR 131 | 1.85 s | 2.10 s | 81.8 |
| | **Wheat** | | | | |
| **ICAR-IARI, RS, Karnal** | Bold seeded | HD 3385 | 2.30 s | 2.40 s | 91.5 |
| | Bold seeded | HD 3410 | 2.30 s | 2.40 s | 93.9 |
| | Bold seeded | HI 1653 | 2.30 s | 2.40 s | 94.4 |
| | Bold seeded | HI 1654 | 2.30 s | 2.40 s | 89.6 |
| **CCS HAU Hisar** | Bold seeded | WH 1309 | 1.80 s, 2.10 s, 2.30 s | 2.10 s | 93.61 |
| | Bold seeded | WH 1402 | | 2.10 s | 83.84 |
| | Bold seeded | DBW 303 | | 2.10 s | 95.27 |
| **SHUATS, Prayagraj** | Medium Bold | AAIW9 | 2.10 s | 2.00 s | 87.0 |
| | Medium Bold | AAIW6 | 2.10 s | 2.00 s | 89.0 |
| | **Chickpea** | | | | |
| **ICAR-NISST, Mau** | Bold seeded | Pusa 3043 | 6.0 r | 6.50 r | 92.24 |
| **MPKV, Rahuri** | Bold seeded | Vishal | 6.0 r | 6.50 r | 90.54 |
| **UAS, Dharwad** | Medium seeded | BGD 204 | 5.5 r | 6.00 r | 84.98 |
| **PDKV, Akola** | Medium seeded | PDKV Gulak | 5.5 r | 5.50 r | 87.0 |
| | Medium seeded | PDKV Harita | 5.5 r | 6.00 r | 95.8 |
| | Medium seeded | Super Jaki | 5.5 r | 6.00 r | 97.8 |
| | Medium seeded | PDKV Kanak | 5.5 r | 6.00 r | 90.5 |
| | Bold seeded | PDKV Kabuli-2 | 6.0 r | 7.00 r | 95.4 |
| | Extreme bold seeded | PDKV Kabuli-4 | 6.0 r | 8.00 r | 95.7 |
| | **Soybean** | | | | |
| **MPKV, Rahuri** | Medium seeded | Phule Kimaya (KDS 753) | 4.0 s | 4.50 s | 91.01 |
| | Medium seeded | Phule Sangam (KDS 726) | 4.0 s | 4.50 s | 90.65 |
| | Medium seeded | Phule Durva (KDS 992) | 4.0 s | 4.50 s | 90.68 |
| **UAS, Dharwad** | Medium seeded | DSb 23 | 4.0 s | 3.75 s | 82.63 |
| **PDKV, Akola** | Medium seeded | PDKV Amba | 4.0 s | 4.00 s | 63.6 |
| | Medium seeded | Suvarna Soya | 4.0 s | 4.00s | 54.1 |
| **UAS, Raichur** | Medium seeded | DSb 34 | 4.0 s | 3.80 s | 92.0 |
| | **Soybean(Veg.)** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **UHS, Bagalkot** | Bold seeded | Krishnaprabha Pinakini | 4.0 s | 4.60 s | 70.28 |
| | **Maize** | | | | |
| **UAS, Bengaluru** | Medium seeded | MAH 14-138 | 6.4/7.0 r | 6.50 r | 93.58 |
| | **Pigeon pea** | | | | |
| **UAS, Bengaluru** | Bold seeded | BRG-5 | 4.75 r | 5.00 r | 91.46 |
| **PDKV, Akola** | Medium seeded | BSMR 853 | 4.0 r | 4.00 r | 92.3 |
| | Medium seeded | PDKV Ashlesha | 4.0 r | 4.75 r | 89.5 |
| | Bold seeded | Maruti | 4.75 r | 4.75 r | 85.2 |
| | Bold seeded | AKT 8811 | 4.75 r | 4.75 r | 88.2 |
| | Bold seeded | Phule Trupti | 4.75 r | 4.75 r | 98.7 |
| **UAS, Raichur** | Small seeded | NAAM 88 | 3.2 r | 3.20 r | 91.5 |
| | **Green gram** | | | | |
| **PAJANCOA & RI, Karaikal** | Medium seeded | VBN 7 | 2.8 s, 3.2 s | 3.00 s | 97.5 |
| **CCS HAU Hisar** | Medium seeded | MH 1762 | 2.8 s, 3.2 s | 2.70 s | 69.99 |
| | Medium seeded | MH 1142 | 2.8 s, 3.2 s | 2.70 s | 89.69 |
| | Medium seeded | MH 421 | 2.8 s, 3.2 s | 2.70 s | 95.44 |
| **`PAU, Ludhiana** | Medium seeded | ML 1808 | 2.8 s | 2.80 s | 94.3 |
| | **Black gram** | | | | |
| **TNAU, Coimbatore** | Bold seeded | ADT 6 | 2.8 s | 3.20 s | 91.2 |
| | Bold seeded | ADT 7 | 2.8 s | 3.20 s | 90.5 |
| **UAS, Dharwad** | Medium seeded | DBGV 5 | 2.8 s | 2.75 s | 86.63 |
| **PAJANCOA & RI, Karaikal** | Medium seeded | VBN 11 | 2.8 s | 2.80 s | 94.4 |
| | **Field bean** | | | | |
| **UAS, Bengaluru** | Medium seeded | HA-5 | - | 6.00 r | 92.57 |
| | **Finger millet** | | | | |
| **UAS, Bengaluru** | - | KMR 630 | 1.4 s | 1.20 r | 90.55 |
| | - | KMR ML-322 | 1.4 s | 1.20 r | 91.68 |
| **TNAU, Coimbatore** | - | ATL 1 | 1.4 s | 1.55 s | 90.3 |
| **UAS, Raichur** | - | Hagari ragi 1 | 1.4 s | 1.40 s | 92.0 |
| | **Barnyard millet** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **TNAU, Coimbatore** | - | ATL 1 | 1.4 s, 1.8 r | 1.40 s | 91.4 |
| **UAS, Raichur** | - | HU-1 | 1.4 s, 1.8 r | 1.40 s | 88.5 |
| | **Foxtail millet** | | | | |
| **TNAU, Coimbatore** | - | ATL 1 | 1.2 s, 1.3 r | 1.30 s | 94.7 |
| **UAS, Raichur** | - | HN 46 | 1.2 s, 1.3 r | 1.20 s | 90.4 |
| **UAS, Bengaluru** | - | GPUF-3 | 1.2 s, 1.3 r | 1.30 r | 90.36 |
| | **Kodo millet** | | | | |
| **TNAU, Coimbatore** | - | ATL 2 | 1.6 s, 2.0 r | 1.50 s | 88.19 |
| **UAS, Raichur** | - | Hagari haraka 1 | 1.6 s, 2.0 r | 1.60 s | 87.25 |
| | **Proso millet** | | | | |
| **UAS, Raichur** | - | HB 1 | 1.6 s | 1.20 s | 81.2 |
| | **Brown top millet** | | | | |
| **UAS, Bengaluru** | - | GPUBT-2 | - | 1.20 r | 83.61 |
| | **Little millet** | | | | |
| **UAS, Bengaluru** | - | GPUL-6 | 1.6 r | 1.00 r | 94.78 |
| | **Sunflower** | | | | |
| **UAS, Bengaluru** | Medium seeded | CMS 1103 A | 2.4 s | 2.40 s | 91.95 |
| | Medium seeded | RHA 92 | 2.4 s | 2.80 s | 90.62 |
| | **Forage crops** | | | | |
| **IGFRI, RRS, Dharwad** | Lucerne | DL 5 | 0.7×0.7×0.7 m | 0.8×20 s | 95.25 |
| | Guinea grass | DGG-1 | 2.4×0.65 | 0.60 r | 94.07 |
| | *Stylosanthes hamata* | Verano | - | 1.80 r | 82.45 |
| | Perennial sorghum | CoFS-29 | - | 2.00 r | 96.20 |
| | *Desmanthus virgatus* | TNDV-1 | - | 2.00 r | 91.58 |
| | *Brachiaria ruziziensis* | DBRS-1 | | 2.10 r | 95.11 |
| | *Macroptilium atropurpureum* | Siratro | - | 2.20 r | 92.00 |

**Conclusion:** The proposed modification shall result in efficient removal of impurities and enhanced recovery of pure seeds. The recommended sieve sizes need to be notified by

DA&FW, GoI and after inclusion in IMSCS would benefit the organizations involved in seed production and marketing.

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## Human Resource Development, Publications and Awards

AICRP on Seed (Crops) with the mandate of human resource development in seed domain, various modules of trainings have been designed by varied cooperating centres to cater the need of seed producing personnel including farmers, trainers and employees (field staff) of State Seed Certification Agency/ State Seed Corporation/ Seed Producer Companies and NGOs. Trainings were mainly focused on seed production, processing, storage, packaging, quality enhancement, quality control and seed health management. According to crop season, need and type of beneficiary, trainings were imparted under AICRP on Seed (Crops) on regular basis under Human Resource Development (HRD) component. Scientific staff of AICRP on Seed (Crops) was also conferred with awards and other recognitions during 2025-26 in various international/ national seminars, conferences and workshops. The efforts made by cooperating centres in capacity building will certainly boost the quality and quantity of the seed and would help in amelioration of Seed Replacement Rate (SRR) in different crops.

During 2025-26, in total 314 training programmes were organized for varied stakeholders of seed industry. Similarly, 86 exhibitions/ kisan melas, were organized on diverse themes related to seed by different cooperating centres. Scientific staffs of AICRP on Seed (Crops) published 299 research papers in the varied journals of national and international repute and also received 25 awards for contributions made in the seed domain.

**Table 7.1: Capacity building programmes, publications and awards under AICRP on Seed (Crops) 2025-26**

| Sl. No. | Centre | No. of Training/ Field Day/ Seed Day | No. of Beneficiaries | No. of Exhibition/ Kisan Mela /Kisan Goshti | No. of Beneficiaries | No. of Publication | | No. of Award |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Research Paper | Other Publication | |
| 1 | AAU, Anand | 2 | 100 | - | - | 2 | 3 | - |
| 2 | AAU, Jorhat | 8 | 244 | 2 | 565 | 1 | 4 | - |
| 3 | ANGRAU, Guntur | 15 | 610 | 4 | 6200 | 12 | 3 | - |
| 4 | AU, Kota | - | - | - | - | 5 | - | - |
| 5 | BAU, Ranchi | - | - | 1 | 3500 | 3 | - | - |
| 6 | BAU, Sabour | 11 | 300 | 1 | 9000 | - | - | - |
| 7 | BCKV, Nadia | 1 | 68 | - | - | 3 | 2 | 1 |
| 8 | BHU, Varanasi | 7 | 166 | 2 | 1200 | 4 | 2 | 0 |

| Sl. No. | Centre | No. of Training/ Field Day/ Seed Day | No. of Beneficiaries | No. of Exhibition/ Kisan Mela /Kisan Goshti | No. of Beneficiaries | No. of Publication | | No. of Award |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Research Paper | Other Publication | |
| 9 | BSKKV, Dapoli | 4 | 120 | 1 | 155 | 6 | 1 | - |
| 10 | BUAT, Banda | - | - | - | - | - | - | - |
| 11 | CAU, Imphal | 7 | 224 | - | - | - | - | - |
| 12 | CCS HAU, Hisar | 4 | 200 | 2 | 53000 | 7 | - | - |
| 13 | CSAUAT, Kanpur | 4 | 436 | 1 | 980 | 2 | 3 | 1 |
| 14 | CSKHPKV, Palampur | - | - | - | - | 7 | 5 | - |
| 15 | GBPUAT, Pantnagar | 0 | 0 | 2 | 5000 | - | - | - |
| 16 | ICAR RC NEH, Manipur | 27 | 1253 | 2 | 270 | - | - | 1 |
| 17 | ICAR-CAZRI, Jodhpur | - | - | - | - | - | - | - |
| 18 | ICAR-CCARI, Goa | 5 | 470 | - | - | - | - | - |
| 19 | ICAR-CIARI, Port Blair | 7 | 174 | - | - | - | - | - |
| 20 | ICAR-CICR, Nagpur | 3 | 130 | 2 | 750 | 2 | 1 | - |
| 21 | ICAR-CRIJAF, Barrackpore | 1 | 20 | - | - | - | - | - |
| 22 | ICAR-IARI, New Delhi | 43 | 10656 | 1 | 2200 | 28 | 16 | 2 |
| 23 | ICAR-IGFRI, Jhansi | - | - | - | - | - | - | - |
| 24 | ICAR-IIGR, Junagadh | 1 | 82 | 2 | 1450 | - | - | 1 |
| 25 | ICAR-IIMR, Hyderabad | 3 | 96 | 1 | 2000 | 1 | 1 | |
| 26 | ICAR-IIMR, Ludhiana | 6 | 345 | 3 | 150 | 1 | 1 | 2 |
| 27 | ICAR-IIOR, Hyderabad | 4 | 135 | 3 | 2700 | | 2 | |
| 28 | ICAR-IIPR, Kanpur | - | - | - | - | 6 | 2 | 1 |
| 29 | ICAR-IIRMR, Bharatpur | 1 | 30 | - | - | - | - | - |
| 30 | ICAR-IIRR, Hyderabad | 9 | 13027 | - | - | 1 | - | - |
| 31 | ICAR-IISR, Lucknow | - | - | - | - | - | - | - |

| Sl. No. | Centre | No. of Training/ Field Day/ Seed Day | No. of Beneficiaries | No. of Exhibition/ Kisan Mela /Kisan Goshti | No. of Beneficiaries | No. of Publication | | No. of Award |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Research Paper | Other Publication | |
| 32 | ICAR-IIWBR, Karnal | 4 | 15395 | - | - | 3 | 3 | - |
| 33 | ICAR-NISST, Mau | 1 | 25 | 1 | 5000 | - | - | - |
| 34 | ICAR-NRRI, Cuttack | - | - | - | - | 3 | - | 1 |
| 35 | ICAR-NSRI, Indore | 1 | 247 | - | - | - | - | - |
| 36 | ICAR-SBI, Coimbatore | 4 | 80 | - | - | - | 1 | - |
| 37 | ICAR-VPKAS, Almora | 4 | 186 | 1 | 29 | - | - | - |
| 38 | IGKV, Raipur | 3 | 270 | 1 | 1000 | 3 | - | 1 |
| 39 | JAU, Junagadh | 2 | 955 | 2 | 2280 | 11 | 10 | 1 |
| 40 | JNKVV, Jabalpur | 3 | 1321 | 4 | 3757 | 15 | 3 | - |
| 41 | KAU, Thrissur | 8 | 1035 | 2 | 4000 | 4 | - | - |
| 42 | MPKV, Rahuri | - | - | 1 | 10000 | 10 | - | - |
| 43 | MPUAT, Udaipur | - | - | - | - | 7 | - | - |
| 44 | NAU, Navsari | - | - | - | - | - | - | - |
| 45 | NDUAT, Ayodhya | 1 | 500 | 1 | 5500 | 10 | 6 | 2 |
| 46 | OUAT, Bhubaneswar | 3 | 300 | - | - | 2 | 3 | - |
| 47 | PAJANCOA & RI, Karaikal | 4 | 155 | - | - | 3 | 3 | - |
| 48 | PAU, Ludhiana | 4 | 244 | 11 | 184900 | 18 | 15 | - |
| 49 | PDKV, Akola | 6 | 558 | - | - | 9 | 2 | - |
| 50 | PJTSAU, Hyderabad | - | - | - | - | 4 | 3 | - |
| 51 | RLBCAU, Jhansi | - | - | - | - | - | - | - |
| 52 | RPCAU, Pusa | 1 | 30 | 1 | 8000 | 3 | 1 | - |
| 53 | RVSKVV, Gwalior | - | - | - | - | - | - | - |
| 54 | SDAU, S. K. Nagar | - | - | - | - | 7 | - | - |

| Sl. No. | Centre | No. of Training/ Field Day/ Seed Day | No. of Beneficiaries | No. of Exhibition/ Kisan Mela /Kisan Goshti | No. of Beneficiaries | No. of Publication | | No. of Award |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Research Paper | Other Publication | |
| 55 | SKRAU, Bikaner | 2 | 90 | - | - | | 3 | - |
| 56 | SKUAST K, Srinagar | 11 | 340 | 2 | 705000 | 6 | - | 1 |
| 57 | SKUAST, Jammu | 18 | 1000 | 2 | 290 | 3 | - | - |
| 58 | SVPUAT, Meerut | 3 | 155 | 1 | 13650 | 2 | 3 | 1 |
| 59 | TNAU, Coimbatore | 6 | 350 | 9 | 35300 | 20 | - | - |
| 60 | UAHS, Shivamogga | 3 | 170 | 4 | 705000 | - | - | - |
| 61 | UAS, Bangalore | 18 | 716 | 7 | 3011000 | 21 | 8 | 3 |
| 62 | UAS, Dharwad | 3 | 1070 | 2 | 7600 | 9 | 1 | 4 |
| 63 | UAS, Raichur | 24 | 3709 | 1 | 250000 | 2 | 11 | - |
| 64 | UBKV, Pundibari | 3 | 130 | - | - | 12 | - | 2 |
| 65 | VNMKV, Parbhani | - | - | 3 | 3300 | 21 | - | - |
| 66 | VSI, Pune | 1 | 80 | - | - | | - | - |
| | **Total** | **314** | **57997** | **86** | **5044726** | **299** | **122** | **25** |




Training on Seed production at ICAR-CCARI, Goa




Training on Seed production at ICAR RC NEH Manipur Centre



Annual Seed Festival at TNAU, Coimbatore



Rabi Krishi Mahotsav at JAU, Junagadh

# Tribal Sub Plan (TSP) Programme

Balanced growth and economic development are the ultimate aim of every country. In spite of significant strides made in agriculture, development is yet to take place in remote areas, which have not received any assistance for their upliftment and the farmers of these areas were still dependent upon the old varieties and landraces in different crops. Hence, Tribal Sub Plan (TSP) was initiated for socio-economic amelioration of the tribal communities with the objectives of organizing seed production in farmers' participatory mode to cater the local demand of quality seed, imparting training on quality seed production, enhancing quality of farm saved seeds, supply of quality seeds, storage structures and other farm inputs (physical assets).

During 2025-26, under AICRP on Seed (Crops), Rs. 232.00 lakhs were released to 20 cooperating centres across the country for organizing mandated activities in tribal areas for the benefit of farmers. Special training programmes on quality seed production in various crops; farmers' participatory seed production activities; distribution of quality seed and fertilizers, seed storage structures, crop protection and small farm equipments; FLDs, exhibitions and exposure visits were instituted by varied cooperating centres benefiting 17640 tribal farmers. *In toto*, 89228 kg of quality seed; 2592 nos of seed storage structures, crop protection equipments and small farm equipments were distributed. Similarly, 79 training programmes on various aspects of seed production, storage and quality enhancement and 1767 FLDs were also organized for the benefit of tribal farmers.

**Table 8.1: Summary of physical achievements under TSP of AICRP on Seed (Crops) during 2025-26**

| S. No. | Centres | Seed distributed (kg.) | Seed storage bins; sprayers, small farm implements (No's) | Training (No's) | FLDs (No's) | Awareness campaign/ Exposure visit (No's) | Beneficiary (No's) |
|---|---|---|---|---|---|---|---|
| 1 | AAU, Anand | 4000 | - | 2 | - | - | 300 |
| 2 | ANGRAU, Guntur | - | - | 1 | - | - | 50 |
| 3 | BSKKV, Dapoli | - | - | 2 | - | 1 | 173 |
| 4 | CSKHPKV, Palampur | - | 140 | 2 | - | - | 140 |
| 5 | ICAR-CICR, Nagpur | 100 | 100 | 1 | - | 2 | 50 |
| 6 | ICAR-NISST, Mau | - | 25 | 1 | - | - | 50 |
| 7 | ICAR-VPKAS, Almora | 3500 | 32 | 1 | 2 | - | 212 |
| 8 | JNKK, Jabalpur | 9600 | - | 2 | 120 | - | 508 |
| 9 | KAU, Pattambhi | 500 | - | 6 | - | 2 | 4100 |
| 10 | MPKV, Rahuri | 11518 | - | 5 | - | - | 443 |
| 11 | NAU, Navsari | 10000 | - | 6 | 154 | 2 | 1348 |
| 12 | PDKV, Akola | 10560 | - | 5 | 420 | - | 1340 |

| S. No. | Centres | Seed distributed (kg.) | Seed storage bins; sprayers, small farm implements (No's) | Training (No's) | FLDs (No's) | Awareness campaign/ Exposure visit (No's) | Beneficiary (No's) |
|---|---|---|---|---|---|---|---|
| 13 | SDAU, S. K. Nagar | 300 | - | 4 | 3 | - | 1168 |
| 14 | SKUAST, Srinagar | 27252 | - | 15 | 928 | 1 | 3401 |
| 15 | TNAU, Coimbatore | 1500 | 1650 | 5 | - | - | 550 |
| 16 | UAHS, Shimoga | 460 | - | 1 | - | 2 | 143 |
| 17 | UAS, Bengaluru | 300 | 600 | 4 | - | - | 702 |
| 18 | UAS, Dharwad | 410 | - | 2 | - | - | 220 |
| 19 | UAS, Raichur | 650 | 45 | 3 | - | - | 565 |
| 20 | UBKV, Pundibari | 8578 | - | 11 | 140 | 1 | 2177 |
| | **Total** | **89228** | **2592** | **79** | **1767** | **11** | **17640** |

Bio-NPK- 100 ltrs; Bio-fertilizer- 280 ltrs; Saplings- 2400 nos; Plant growth promoters- 120 ltrs; Poultry chicks- 20 nos; Pesticides- 599.6 ltrs; Fertilizers- 4800 kgs.



**TSP activity at AAU, Anand**



**TSP activity at TNAU, Coimbatore**



**TSP activity at CSKHPKV, Palampur**



**TSP activity at JNKVV, Jabalpur**




TSP activity at KAU, Thrissur




TSP activity at SKUAST-K, Srinagar



TSP activity at UAS, Bangalore



TSP activity at UAS, Raichur



TSP activity at UBKV, Pundibari



TSP activity at MPKV, Rahuri

# Status of AICRP on Seed (Crops) - Revolving Fund

Indian Council of Agricultural Research (ICAR) took firm steps as early as 1979-80 by launching AICRP–National Seed Project (Crops) and created as many as 41 Breeder Seed Production (BSP) units in almost all State Agricultural Universities and crop based ICAR institutes to cater to the requirement of breeder seeds in different crops. To support and strengthen breeder seed production programme, ICAR during VIII Plan made the provision of revolving fund with a policy of single window system for stringent compliance to avoid operational problem of recurring fund in the BSP centres.

Further during 2005-06, ICAR launched ICAR Seed Project to augment the quality seed production and seed infrastructure in the country. During X plan period, provision of revolving fund was made to all existing centres. During 2021-22, both the i.e., AICRP on NSP Crops) and ICAR Seed Project were merged as single entity 'AICRP on Seed (Crops)'. In few centres, the two revolving funds were merged and in most of the centres, they are operating independently. To make the system more efficient, vibrant, accountable and sustainable, centres were instructed to operate single account of the fund and the Nodal Officers were entrusted with the responsibility of fund operation. It is mentionable that profits earned by the centres were ploughed back in the system for creation of infrastructure facilities to enhance the capability of QSP units.

**Highlights**

1. Revolving fund has made significant impact in enhancing breeder seed production and production of other classes of seed in the country as a whole and subsequently strengthened the infrastructure facilities at all cooperating centres of AICRP on Seed (Crops).
2. At the end of FY 2024-25, all the centres had positive balance in the revolving fund account and collective balance at the end of referred FY under revolving fund scheme was Rs. 8979.38 lakhs.
3. PAU, Ludhiana; JAU, Junagadh; UAS, Dharwad; ICAR-IIWBR, Karnal; TNAU, Coimbatore; VNMKV, Parbhani; IGKV, Raipur; MPKV, Rahuri; SKRAU, Bikaner; UAS, Bangalore performed better in terms of generating the revenues under seed revolving fund.
4. All the centres have refunded the revolving fund amount under breeder seed production scheme. Centres have invested the profit obtained through the operation of revolving funds for infrastructure development in their respective centres.

**Table 9.1: Utilization of revolving fund under AICRP on Seed (Crops) during 2024-25**

**(Rs. in lakhs)**

| Sl. No. | Centre | Initial seed money sanctioned | Seed money refunded to ICAR till date | Opening balance as on 1st April 2024 | Revenue generated during 2024-25 | Profits utilized during 2024-25 | Balance on 31st March, 2025 |
|---|---|---|---|---|---|---|---|
| 1 | AAU, Anand | 41.50 | 41.50 | 167.83 | 61.08 | 93.52 | 135.39 |
| 2 | BAU, Ranchi | 39.50 | 39.50 | 0.53 | 16.59 | 10.73 | 5.33 |
| 3 | BCKV, Nadia | 15.00 | 15.00 | 150.35 | 70.03 | 37.17 | 220.38 |
| 4 | BSKKV, Dapoli | 59.90 | 59.90 | 23.87 | 16.39 | 12.50 | 27.76 |
| 5 | CCS HAU, Hisar | 76.82 | 76.82 | 38.48 | 59.00 | 15.52 | 41.22 |
| 6 | CSAUAT, Kanpur | 72.50 | 37.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | CSKHPKV, Palampur (BSP) | | | | | | |
| | Breeder seed production | 6.00 | 6.00 | 41.54 | 43.75 | 0.00 | 45.00 |
| | ICAR seed project | 20.00 | 20.00 | 33.16 | 20.39 | 0.00 | 33.12 |
| 8 | GBPUAT, Pantnagar | 70.32 | 18.00 | 253.41 | 452.93 | 548.09 | 158.25 |
| 9 | IGKV, Raipur | 54.00 | 54.00 | 270.52 | 224.23 | 3.29 | 494.76 |
| 10 | JAU, Junagadh | 51.10 | 51.10 | 985.65 | 346.92 | 274.31 | 1058.26 |
| 11 | JNKVV, Jabalpur | 86.50 | 81.00 | 13.29 | 381.18 | 359.33 | 8.14 |
| 12 | KAU, Thrissur | 50.82 | 14.00 | 24.82 | 43.19 | 42.45 | 25.21 |
| 13 | MPKV, Rahuri | 87.00 | 87.00 | 300.36 | 775.87 | 97.03 | 397.39 |
| 14 | NAU, Navsari | 30.00 | 30.00 | 1.91 | 49.93 | 58.11 | 182.81 |
| 15 | NDUAT, Ayodhya | 60.50 | 10.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | OUAT, Bhubaneswar | 43.50 | 29.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | PAU, Ludhiana | 65.00 | 65.00 | 1788.62 | 292.96 | 345.35 | 1736.23 |
| 18 | PDKV, Akola | 69.25 | 69.25 | 0.00 | 0.00 | 0.00 | 0.00 |
| 19 | PJTSAU, Hyderabad | 73.00 | 58.00 | 141.72 | 67.97 | 0.00 | 209.69 |
| 20 | SDAU, SK Nagar | 65.00 | 54.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| Sl. No. | Centre | Initial seed money sanctioned | Seed money refunded to ICAR till date | Opening balance as on 1st April 2024 | Revenue generated during 2024-25 | Profits utilized during 2024-25 | Balance on 31st March, 2025 |
|---|---|---|---|---|---|---|---|
| 21 | SKRAU, Bikaner | 40.00 | 40.00 | 290.58 | 71.20 | 0.00 | 361.78 |
| 22 | SKUAST, Jammu | 25.00 | 25.00 | 402.94 | 0.00 | 0.00 | 0.00 |
| 23 | SKUAST K, Srinagar | 34.50 | 29.00 | 57.44 | 15.05 | 7.50 | 64.94 |
| 24 | SVPUAT, Meerut | 20.00 | 20.00 | 256.73 | 95.79 | 116.46 | 160.94 |
| 25 | TNAU, Coimbatore | | | | | | |
| | Breeder seed production | 18.00 | 18.00 | 65.48 | 108.18 | 113.75 | 59.90 |
| | ICAR seed project | 55.00 | 55.00 | 384.03 | 449.63 | 432.95 | 400.71 |
| 26 | UAS, Bangalore | 77.32 | 77.32 | 313.27 | 201.75 | 9.49 | 322.76 |
| 27 | UAS, Dharwad | 63.00 | 63.00 | 1105.68 | 2634.19 | 0.00 | 958.22 |
| 28 | VNMKV, Parbhani | 55.00 | 55.00 | 793.46 | 481.84 | 768.19 | 507.11 |
| 29 | UBKV, Pundibari | 25.50 | 25.50 | 169.82 | 4.53 | 3.52 | 170.83 |
| 30 | MPUAT, Udaipur | 44.32 | 44.32 | 0.00 | 0.00 | 0.00 | 0.00 |
| 31 | BHU, Varanasi | 30.50 | 25.00 | 32.22 | 31.18 | 33.15 | 32.25 |
| 32 | RPCAU, Pusa | 40.50 | 10.00 | 23.90 | 73.94 | 4.97 | 92.86 |
| 33 | CAZRI, Jodhpur | 13.00 | 13.00 | 113.13 | 35.20 | 83.59 | 24.94 |
| 34 | CICR, Nagpur | 10.00 | 10.00 | 0.00 | 18.74 | 12.57 | 6.17 |
| 35 | CRIJAF, Barrackpore | 12.00 | 12.00 | 9.92 | 23.15 | 27.31 | 5.76 |
| 36 | IIOR, Hyderabad | 5.00 | 5.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| 37 | IGFRI, Jhansi | 13.00 | 13.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 38 | IIMR, Hyderabad | 15.50 | 15.50 | 155.21 | 49.15 | 51.97 | 86.79 |
| 39 | IIPR, Kanpur | 15.00 | 15.00 | 143.40 | 92.17 | 67.91 | 23.40 |
| 40 | IIRR, Hyderabad | 9.82 | 9.82 | 4.54 | 56.50 | 41.19 | 0.87 |
| 41 | NRRI, Cuttack | 15.00 | 15.00 | 39.72 | 97.59 | 16.03 | 29.87 |

| Sl. No. | Centre | Initial seed money sanctioned | Seed money refunded to ICAR till date | Opening balance as on 1st April 2024 | Revenue generated during 2024-25 | Profits utilized during 2024-25 | Balance on 31st March, 2025 |
|---|---|---|---|---|---|---|---|
| 42 | VPKAS, Almora | 9.50 | 9.50 | 0.00 | 0.00 | 0.00 | 0.00 |
| 43 | IARI, New Delhi | 45.00 | 45.00 | 0.00 | 1147.29 | 301.53 | 0.00 |
| 44 | IIWBR, Karnal | 5.00 | 5.00 | 804.09 | 839.36 | 130.26 | 546.87 |
| 45 | IIRMR, Bharatpur | 5.00 | 5.00 | 56.30 | 145.77 | 133.52 | 45.16 |
| 46 | NSRI, Indore | 10.00 | 10.00 | 91.54 | 75.39 | 115.40 | 51.53 |
| 47 | IIGR, Junagadh | 10.00 | 10.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 48 | IISR, Lucknow | 10.00 | 10.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 49 | SBI, Coimbatore | 10.00 | 10.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 50 | NISST, Mau | 5.00 | 5.00 | 209.15 | 266.56 | 60.78 | 128.36 |
| 51 | CCARI, Goa | 18.82 | 16.29 | 6.09 | 10.03 | 6.51 | 9.08 |
| 52 | CIARI, Port Blair | 17.00 | 14.26 | 0.00 | 0.00 | 0.00 | 0.00 |
| 53 | VSI, Pune | 20.00 | 20.00 | 0.08 | 25.00 | 25.07 | 0.01 |
| 54 | AAU, Jorhat | 41.82 | 41.82 | 24.92 | 28.64 | 2.48 | 27.40 |
| 55 | CAU, Imphal | 28.00 | 28.00 | 75.97 | 11.61 | 0.00 | 81.93 |
| | **Total** | **2009.31** | **1741.90** | **9865.67** | **10011.85** | **4463.49** | **8979.38** |

**Note:**

1. All centres have returned the sanctioned amount to council under breeder seed production scheme
2. All centres are using single window system
3. At almost all centres the revolving of BSP and ICAR Seed Project have been merged

# *At a Glance*

## Summary of quality seed production during 2025-26 under AICRP on Seed (Crops)

(in quintals)

| S. No. | Particulars | In University/Institute | | Participatory Seed Production | | Total | |
|---|---|---|---|---|---|---|---|
| | | Target | Production | Target | Production | Target | Production |
| 1 | Breeder seed | 78022.82 | 116797.95 | - | - | **78022.82** | **116797.95** |
| 2 | Foundation seed | 75140.73 | 89665.04 | 24412.70 | 51853.95 | **99553.43** | **141518.99** |
| 3 | Certified seed | 62701.29 | 71154.68 | 51420.33 | 89961.49 | **114121.62** | **161116.17** |
| 4 | TFL seed | 54776.84 | 65252.29 | 41725.44 | 81949.57 | **96502.28** | **147201.86** |
| 5 | Planting material | 26785.22 | 47712.66 | - | - | **26785.22** | **47712.66** |
| | **Total** | **297426.90** | **390582.61** | **117558.47** | **223765.01** | **414985.37** | **614347.62** |

(in lakh)

| S. No. | Particulars | Target | Production | Target | Production | Target | Production |
|---|---|---|---|---|---|---|---|
| 1 | Planting material | 184.80 | 205.33 | - | - | 184.80 | 205.33 |
| 2 | Tissue culture plants | 8.80 | 12.42 | - | - | 8.80 | 12.42 |
| | **Total** | **193.60** | **217.75** | **0.00** | **0.00** | **193.60** | **217.75** |



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